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# AIRCRAFT DEVELOPMENTS *

W. E. GILMORE, U.S.A., Brigadier General, Air Corps, Chief Material Division, Wright Field, Dayton, Ohio. (Now Assistant Chief and Chief, Training and Operations Division, War Department, Washington, D. C.

It is a very great pleasure for me to meet with this Society tonight. I am especially gratified that Dean Kimball is presiding here because it was my pleasure and honor to serve with Dean Kimball on the faculty at Cornell University and help, in my small way, to start some of the students at Cornell in the military life.

I had prepared a rather formal talk for this evening. It was a pretty good cool-evening talk. I am going to discard it and will try to tell you, as briefly as I can, what we are doing, or trying to do, at the Engineering Laboratories at Wright Field in Dayton.

As you know, our game is comparatively young. If you stop to figure that twenty-five years ago last December the Wright Brothers made their first flight in the heavier-than-air machine, powered with a twelve horse power motor, making a speed of about thirty-five miles an hour, you will know that advances have been made.

One quick way to review what has happened in twenty-five years is to see what we are doing now in the way of horse power and speed. We have designed and built, under the direction of our engineers at Wright Field, ships with 2400 horse power installed, weighing 40,000 pounds. We have built and developed ships with a high speed of 265 miles an hour. We have developed motors up to 1200 horse power. That reviews some of the outstanding engineering feats that have taken place in this game in twenty-five years.

But, it has not been as easy, or as sudden, as that review might indicate. It has been the result of good, hard study and good, sound engineering.

* Presented at the 37th annual meeting of the Society, Ohio State University, Columbus, Ohio, June 19–22, 1929.

You might divide the development of aeronautics into three periods. The first ten years was a sort of exhibition, or sporting, period. The machines were lightweight,—they had no military value, they were used mostly for exhibition purposes around the country at fairs and gatherings, meets, and so forth. The development was not very rapid.

Then the World War came on. That was the period responsible for the great development of aviation, because every country concerned turned over to its engineers all the money they needed for experimental engineering. The engineers did not have to ask for money. Their War Departments, and their Navy Departments, were urging them to development, urging them to take money and develop power plants and develop machines with better aerodynamic characteristics, develop all the equipment that goes on the machine. Money was unlimited.

In that period from 1914 to 1924 we saw the military development of aviation. Then came the third period, or the period we are in now, commercial development. We are just on the eve of that. Neither you nor I—and I do not care how good an imagination we may have—can picture what that development will be. There is no doubt about it. People are going to have fast transportation. Every country that has been developed to a high state of civilization can trace it back to methods of communication and transportation. In this country we are always demanding the highest speed that we can attain on our roads, on the railroads, on ships and now in the air.

We have been going along at a speed of about an average of 100 miles an hour for our commercial ships. That is not fast enough. The commercial builders now are looking forward to a cruising speed of 140 miles an hour. Their engineers are figuring ahead to a cruising speed of 160 miles an hour. We, in the Army, are setting our standard on fast ships at 200 miles an hour, so that this great demand for speed, of course, makes it necessary for research engineers to develop those things that will give you the speed, better power plants, better aerodynamic characteristics of ships,

cleaning them up all over, reducing the parasite resistance wherever it is possible, reducing weight, all of those things, that give you speed.

In the laboratories at Wright Field, which our great Government provided, we are working on all of these problems. It is hard to comprehend just how many problems there are in the development of aviation. Added to all the commercial problems, we in the military service have the problem of armament, of fitting in bow guns, fitting in rear guns, fitting in bombs, bomb racks, bomb releases, bomb seats, fitting in great photographic cameras for air photography, all of these things must go into the ship to give it military value. The commercial man does not have that problem. But, we work on these problems at Wright Field laboratories. We work with the commercial engineers and we are always happy to turn over to them the results of our work.

On safety devices: You read of the parachute and you see a parachute strapped to a pilot. It looks like a fairly simple device. I dare say that we spent a half million dollars developing the parachute. We have developed it to the stage where we have never had a failure in a live jump with one of our standard Army parachutes. We have never known a case of a man getting out of a ship and pulling the ring on his parachute and not being saved. That has been the result of years and years of work, to make that parachute the safety appliance that it is. Not long ago there was a rather amusing incident that happened in connection with parachutes, when two of our men were going from San Antonio, Texas, to Dallas, Texas, both pilots. Naturally, the man in the front seat had control of the ship and was doing the flying. They had been to San Antonio to a party. The man in the rear seat decided he would sleep on the way to Dallas. After they took off from San Antonio he promptly went to sleep. The air in Texas at times gets very rough due to the sudden changes of temperature, the high heat, the air currents, and it gets just as rough as the English Channel, and those of you who have crossed the English Channel on a rough passage can appreciate what rough air means. These men were flying along and

without knowing what happened the man in the rear seat found himself out of the ship. He had been asleep and had awakened out in the air. He reached over and pulled the ring on his parachute, made a perfectly normal descent and landed. Then he began to try to get into communication with the field at Dallas. The man in the front seat, who was flying the ship, got the greater thrill of the two men when he landed, because he turned around to speak to his friend and he was not there. To date, over 100 of our men owe their lives to this safety appliance.

There are many other developments that I would like to talk to you about, and there are a lot of romantic stories connected with them. We have a man working on a plane parachute now. It is an eighty-foot parachute, eighty feet in diameter and it is used for parachuting a plane that has met with some accident or is out of control in order to save the lives of the people in the plane. That work is going on at Wright Field and while it has been attempted by other people in some measure we believe that our work at Wright Field has a lot more chance for success.

The development of the power plant has been an interesting story. You men who are interested in power plant engineering know what has happened. The first motors weighed sixteen pounds per horse power. Today we are down to a half pound per horse power. We are striving constantly for that goal of less weight and greater power. We are striving for the goal of turning our motors up to a higher r.p.m. and getting more efficiency out of fuel, getting more efficiency out of all of our equipment.

Our great Government has been very liberal to the army air service in promoting this work at the laboratories at Dayton. They have built us a laboratory the buildings for which have cost a little over $3,000,000 and they have let us spend several millions for equipment for those laboratories, so that today we are undoubtedly the best equipped aeronautical engineering activity in the whole world. When I say that, I know what I am talking of because only last fall I spent three months in Europe visiting the various experimental labora-

tories. A lot of us in this country had the feeling—and I know that I had the same feeling at one time—of a sort of inferiority complex about our aeronautical development. Mr. Brisbane in the Hearst Newspapers has harped on that constantly. And a lot of other people did the same thing. Yet, when you visit any country in Europe and talk with the engineering men there they will tell you that they are all jealous of the progress of the United States. We really do more flying here in a week than they do in all of Europe in a month. The European lines are well advertised, they are advertised because they are all subsidized. If you have someone paying your advertising bill you can do a lot of advertising. That is exactly the position of all of the Governmental lines in Europe. Every one of them is subsidized and it runs from about 20 per cent subsidy on the Holland Line, to Germany where it goes up to eighty per cent. The Germans, as you know, have no military aeronautics but they are spending a lot of effort and money on commercial aeronautics because the Treaty allowed them to go on with their commercial development

Briefly, I want to call attention to some of the things that I think of as outstanding in our work at Wright Field. We have recently completed successful tests on cooling of water-cooled motors with Ethelyne-Glycol. I think that is the outstanding accomplishment of the Laboratories for the last several years. It puts the water-cooled motor in a very favorable position with the air-cooled or radial motor. It reduces the weight very considerably on a standard ship. It will reduce it about 125 pounds, and it reduces the parasite resistance of the radiator by 75 to 80 per cent. It makes the motor much more efficient because it runs at a higher temperature, and the fuel economy is considerable. That is an accomplishment of which we are very proud because it means better equipment, and it means a lesser load, by 125 pounds. You can put in bombs or ammunition, or the commercial man can put some 125-pound person in there and that means money in his pocket.

Our aerial camera development has been interesting be-

cause, after all, it has a great commercial use. We are sending, next month, Captain Stevens and Lieutenant Corkille to the western country where we expect to photograph objects at a distance of over 200 miles. We have successfully photographed objects up to 175 miles. I have no doubt but that Stevens, who is probably the outstanding aerial photographer of the world, will do exactly what he is setting out to do. He is a man who eats and sleeps with his photographic development. His work with the triple lens camera for aerial mapping has been marvelous. We get wonderfully clear pictures in his work with night photography. This is done from high altitudes. They are of great military value.

One ship with one of the five-lens cameras can go up in certain parts of our country and do as much work in one hour's flying as 100 engineers working on the same ground on a survey would do in a month. You can see where it has a real commercial value and where the Government is giving back to the people some results on the expenditure for this work.

Our bombing development is probably the most wonderful military development that we have had since the war, in the accuracy and effectiveness of our bombing.

Not long ago we were given a problem of destroying the Pee-Dee River Bridge. This was a reinforced concrete bridge, and due to a power development the company doing the power development built another bridge to replace this one. They gave this bridge to the War Department to destroy with gun fire and with bombs. It gave us somewhat of a problem because the bridge was only twenty feet wide and we were to start to bomb it from an altitude of 10,000 feet.

You men who are engineers will appreciate the problem presented in the flight of a bomb by a change in the direction of the wind, or in the velocity of the wind, or of a little parasite resistance on a bomb, how much those things would change the flight of the bomb from great heights and deflect it off its twenty-foot target. Yet, our work on that bridge was very successful as you will see in the pictures.

We have built a marvelous new propellor test rig out at

Wright Field. The propeller test rigs have cost over $750,000 to date and are not yet complete. We can put 6000 horse power on one rig and swing a 40-foot propeller and when completed we will have an additional rig of 3000 horse power and one of 25,000 horse power so arranged that we can get the slip stream of one propeller onto the other propeller while it is working.

We have looked as far ahead as we can in this work and we believe that a forty-foot propeller answers the problem of propeller testing for many years to come.

In our dynamometer laboratory we have stands for testing motors of every horse power that we can forsee, both in water-cooled and in air-cooled radial motors and we are able to do this at different temperatures.

You will appreciate that we have a good many problems. One of our pilots today may be taking off in a super-charged ship, from the ground, with the temperature what it was at ten o'clock this morning. Inside of an hour he is up to a temperature of 75 degrees below zero. That motor has to operate just as efficiently at a ground temperature of 85°, as it has to at a temperature of 75 degress below zero, otherwise it cannot be classed as a military-successful motor.

Those are problems that the average layman does not appreciate. You will see in the pictures our men doing high altitude photography and high altitude flying. That is possible by engineering development. The super-charged motor, the liquid oxygen that the pilot and the observer uses, the aerodynamic qualities of the ship that we use, the sturdiness of the motor, all make it possible to do this sort of work.

Instruments have had a remarkable development. They are so accurate. The earth inductor compass made it possible for Lindbergh to make his successful flight and hit the Irish coast within two miles of where he had planned to hit it.

We do not claim at the laboratories that we are responsible for every recent modern development in aeronautics. We do claim that we are responsible for the development of most of these things that are successful now because almost every inventor, almost every engineer comes to us sooner or later

with his device, and with our means of helping him and our experience, we are more apt to make it a success than would be possible if the inventor were working alone, even if he had the money to carry it through.

This problem of engineering education is one that is very close to my heart. During the last year and a half we have lost, in our laboratories, a very large percentage of our key men. They have gone out into the aviation industry. We have lost twenty-eight of our principal men from the dynamometer laboratory in the last seven months. You men who are in industry know what that means, that turnover. It is terrific.

Yet, we are not worrying about it. It slows us up, but those men are going out into commercial aviation. They have been trained at the Army laboratories and in the event of an emergency those men will be in the aviation industry and when we go to them with problems for the Army Air Corps, we will find a Wright Field man there who talks our language and knows how we work.

That personnel problem is one that we are trying to handle by bringing in young men from the Universities. We are bringing in the young men who are interested in aerodynamic engineering, power plant engineering, or whatever sort of aviation engineering they are interested in. They are sure to find a place in our laboratory.

I think this personnel problem will solve itself in the next few years because so many young men are interested in this game of aeronautics. They are studying it now at the Universities where it is taught, and they are now getting practical knowledge with the commercial concerns. In a few years, I think, the supply of engineers will be ample. Right now, it holds a great future.

I do not know whether you realize it or not, but there are a billion dollars invested in the aeronautic industry now. This development in the last two or three years has gone beyond anything that anyone ever dreamed of. It has not been a gradual development like the automotive industry. It just jumped ahead following Lindbergh's flight and if any-

one here can tell me where it is going, I would be very much obliged.

I do know that these various aviation companies have no trouble at all in getting capital. Their greatest trouble now is finding pilots for ships. The engineering, unfortunately, of some of the commercial companies is not as sound as it should be. It is going to result in a lot of unfortunate accidents. But, even accidents cannot stop this transportation development. People accept the fact that they are going to have this fast method of transportation. I do not think there is any doubt at all, that in fifteen years practically every one who now travels on a pullman car—certainly everyone travelling on excess fare trains—will be travelling by airplane if he is going to travel any distance where it will pay him to go out to the air port and take a plane to get to his destination. You will be travelling at 200 miles an hour, perfectly safe as far as a speed of 200 miles an hour is concerned, and certainly it will be a wonderful saving in time.

## THE DANIEL GUGGENHEIM FUND FOR THE PROMOTION OF AERONAUTICS, INC.

September 24, 1929

As a result of tests successfully conducted this morning at Mitchel Field, the Daniel Guggenheim Fund for the Promotion of Aeronautics is able to report a solution of the hitherto unsolved last phase in the problem of flying through fog. Under conditions representing the densest fog, reaching from any altitude to the ground, Lieutenant James H. Doolittle, conducting the experiment, was able to take off from the airport, fly from it and return to a given spot and make a landing. This brief summary of the experiment and its significance is sent to you as a matter of interest.

HARRY F. GUGGENHEIM, *President*

The demonstration represents the successful consummation of experiments which have been conducted for nearly a year over the full-flight laboratory established by the Fund at Mitchel Field. The principal factors in making possible the accomplishment are a new application of the visual radio beacon, the development of an improved instrument for indicating the longitudinal and lateral attitude of an airplane, a new directional gyroscope and a sensitive barometric altimeter so delicate as to measure the altitude of the airplane within a few feet of the ground.

The test plane used in these experiments was equipped with a completely covered cockpit. Unable to see outside the cockpit and guided entirely by his instruments, Lieutenant Doolittle took off from Mitchel Field, flew away from the field, turned around, recrossed it, turned again and came back, landing a short distance from his starting point. In the place of the natural horizon by means of which the pilot usually keeps his plane at a stable and safe flying attitude, and which would be invisible in fog, Lieutenant Doolittle used an "artificial horizon" in the form of a small instrument indicating to the pilot the longitudinal and lateral attitude of the airplane with relation to the ground at all times.

With stability thus assured, the pilot was able to locate the landing field by means of the direction-finding radio. In addition to the long-distance radio beacon already in use at Mitchel Field and known to this country for some time, a beacon had been installed governing the immediate approach

to the field, casting a beam of some 15 or 20 miles in length in either direction. On the instrument board of the plane a visual radio receiver, consisting of two vibrating reeds tuned to the radio beacon, enabled the pilot to determine the location of the beam and thus the landing field. If he turned to the right of his course, the right reed showed an excessive vibration, and vice versa, and by keeping the reeds in equilibrium the pilot was able to fly directly down the path of the beam to his landing. The sensitive altimeter showed him his altitude and made it possible for him to calculate his landing to a distance of within a few feet of the ground.

The demonstration eliminates the last great hazard to the reliability of airplane travel and means that a principle has been developed which when eventually perfected for commercial use will make the airplane more independent of weather conditions than any other form of transportation. I say "more independent" advisedly because the aircraft is not limited to one plane of travel and can take advantage of a number of approaches to its destination without using a congested roadway or water channel.

It is significant that the achievement is realized through the aid of only three instruments which are not already the standard equipment of an airplane. In other words, with the commercial manufacture of these instruments, the necessary equipment for fog flying will be neither expensive nor complicated, but of such a nature that it is readily available to the average pilot, and easily comprehended. The commercial practicality of the development is, therefore, assured from the start.

Many individuals and organizations have participated in making this development possible. Lieutenant Doolittle has been in charge of the full-flight laboratory from the start, and was made available for this work through the courtesy of the Army Air Corps. He studied at both the University of California and the Massachusetts Institute of Technology, and his aeronautical achievements, including the winning of the Schneider Cup Race in 1925, rank him as one of the country's leading pilots. Professor William Brown of the Department

of Aeronautics, Massachusetts Institute of Technology, was his technical assistant and for some time has been actively engaged in various phases of aviation with the Navy, the Army and the National Advisory Committee for Aeronautics.

The Bureau of Standards and the United States Army and Navy have both contributed to the work, and mention should also be made of the following companies whose instruments and experimentations made possible the necessary equipment: Pioneer Instrument Company, Taylor Instrument Company, Sperry Gyroscope Company, Bell Laboratories, Radio Frequency Laboratories, and Kollsman Instrument Company.

The new principle which has been demonstrated solves what I have considered in the past one of the two remaining fundamental problems of aviation. The application of this principle, however, and the final perfection of the best equipment for all phases of fog flying will require time and effort on the part of commercial and military organizations.

For example, in our demonstration, use was made of the barometric altimeter which must be corrected for variation of atmospheric conditions. This correction is made by telephonic communication from the ground to the plane. Other altimeters not subject to atmospheric change are now in process of development, and the Fund is assisting in this experimentation. Notable among these is the sonic altimeter, a development by Dr. Elmer Sperry, and the radio altimeter now being developed by the General Electric Company.

Also, while the pilot flies at sufficient altitude to clear all surrounding obstructions in coming into the field, the problem of collision with other aircraft in the air when flying through fog is a serious one. This can only be eliminated today by telephonic orders from the ground directing the planes flying over the same routes so as to keep out of each other's way. The perfection of an instrument to warn of the approach of another plane is a device for the future. In addition, while the particular beacon used in the Fund's experiment is located at the edge of the field, the beacons of the future will be so located that it will be possible to land always into the wind. These are examples of the developments that should be greatly stimulated from now on.

# REPORTS OF COMMITTEES OF THE 1929 SESSION OF THE SUMMER SCHOOL FOR ENGINEERING TEACHERS

The following reports were prepared by committees of the members of the Mechanical Engineering Session of the Summer School for Engineering Teachers. They are intended, in some measure, to bring together some of the results of the discussions and papers of the session, though they are not necessarily limited to such summarization. The reports were prepared and presented to the session in preliminary form and were then discussed. In some instances they were adopted without modification. In others modifications were voted by the members of the session. In most instances the various portions of the reports were finally adopted unanimously; in others there was a division of opinion; but no record of the division is contained herein.

The reports do not constitute an attempt to legislate on matters relating to the teaching of mechanical engineering but merely to record the majority opinion of the summer school group and to serve as a stimulus for further study and discussion. They are published to that end.

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## REPORT OF COMMITTEE NO. 1 ON PREREQUISITES IN MECHANICAL ENGINEERING CURRICULA

1. The term *prerequisite* appears to have different meanings in different institutions and for the purpose of clarifying this situation it is suggested that the term be used to designate only those courses, the satisfactory completion of which is considered essential for the successful pursuit of subsequent courses.

2. The committee believes that a system of prescribed pre-

requisites is desirable in an engineering curriculum since such curricula are in large part composed of sequences of courses which follow in logical order throughout part or all of the four years. In such sequences of courses, principles and methods are developed in a definite order, the successive steps in one course preparing the way for those that follow. In many of the advanced courses, the student is required frequently, in fact in some cases continually, to employ principles learned in one or more earlier courses.

3. Your committee believes that mechanical engineering curricula in general are rather rigid in requirements and possibly somewhat less flexible than is desirable. The committee therefore is not disposed to make any suggestions or recommendations that would add to any such rigidity as may now exist or which would tend to reduce flexibility in any way. In accordance with the definition given in paragraph 1, the committee believes, therefore, that only such courses as are essential should be prescribed.

4. Your committee recognizes that there are differences in the practices of various institutions which are desirable if not indeed necessary, and hence no universally applicable system of prerequisites would be feasible. The committee, therefore, does not submit any formal recommendations but merely presents the following suggestions for your consideration:

(*a*) No course should be prescribed as a prerequisite which does not embody principles and subject matter which are essential to the successful pursuit of a subsequent course.

(*b*) A student who has not passed a prerequisite course should not be permitted to pursue the advanced course, except that under certain conditions a student who has attended class throughout an entire prerequisite course but has not achieved a passing grade, may be admitted conditionally to the subsequent course.

(*c*) The administration of prerequisite requirements should not be a matter of mere office routine. The waiving of such requirements should not be done without the approval of the

heads of departments giving the prerequisite course and the subsequent course.

Respectfully submitted,

JOHN R. DUPRIEST, *Chairman*,
LEE L. AMIDON,
F. S. EGILSRUD,
ALFRED FERRETTI,
NORMAN M. HALL,
FLOYD E. MEHRHOF,
H. E. ROSSELL,
H. P. HAMMOND, *Adviser*.

## REPORT OF COMMITTEE NO. 2 ON ENGINEERING INSPECTION TRIPS

It is the unanimous opinion of the committee that a well planned and organized inspection trip is more than worth the time and money expended, and we recommend its general practice.

### Aims and Purposes.

The aims and purposes of an engineering inspection trip are:

1. To give the student some acquaintance with the realities of engineering practice.
2. To familiarize the student with the type of work expected of young engineers in industry.
3. To enable the student to make contact with the officials of various firms.
4. In general, to give the student the benefit of the broadening influence which results from a well planned itinerary.

### Planning the Trip.

The size of the school and its location relative to various industries vary to such an extent that the committee does not deem it advisable to formulate specific recommendations that will apply in all cases. However, it believes that the following suggestions will be helpful:

1. Not too strenuous an itinerary should be attempted as a few plants thoroughly inspected will be more beneficial than a larger number casually visited.

2. Great care should be exercised in selecting plants that will bring out the aims and purposes of the visit. The plant should be asked to furnish an ample number of suitable guides who are thoroughly familiar with all phases of the plant to be inspected.

3. In order that the student may have the necessary background to profit most from such a trip, the committee believes that the trip should not be made before the Junior year. This does not prevent first and second year students from making short local trips in conjunction with regular class work.

4. The committee believes that not more than one week of inspection will be justified from both a financial and time-consuming standpoint.

5. The supervision of the trip should be vested in a committee composed of members of the teaching staff of the division of engineering in which the students are registered. The committee should accompany the students on the trip as official college representatives with full power to handle all questions pertaining to the trip.

6. A detailed, printed schedule of the itinerary containing information as to when and how to get to and from the various places should be given to each student and also sent to each of the plants to be visited.

7. Instructors accompanying the students on the trip should meet with them several times before the date of departure and give them detailed instructions regarding every phase of the trip.

8. In arranging inspection trips, it is suggested that nearby meetings of engineering societies or their local sections be taken into consideration and cooperative trips arranged if possible.

**Conducting the Trip.**

1. A member of the teaching staff should be assigned to each group of from twenty to twenty-five students and he should have full charge of this group during the entire trip. Each group should be sub-divided into four or five squads with an assigned monitor or group leader for each. This will simplify keeping in touch with each student and conveying orders from the staff member to his entire group.

2. Whatever mode of transportation is used, the entire party should go intact.

3. There should be a central headquarters and the entire party should stay there.

4. Special groups interested in a particular field may be organized and special trips arranged for them.

**Reports.**

1. It is the opinion of the committee that a general report of the entire trip and a detailed report of some particular plant visited should be required of each student.

2. Students should be asked to submit suggestions and criticisms in their reports.

3. If curriculum credit for the trip is allowed, it should be computed on a laboratory time basis.

Respectfully submitted,

JILES W. HANEY, *Chairman*,
EDWARD ANDERSON,
H. S. CAMERON,
F. S. GRIFFIN,
O. K. HARLAN,
A. V. KILPATRICK,
C. W. LARSON,
H. F. ROEMMELE,
G. F. YOTT,
G. A. YOUNG, *Adviser*.

## REPORT OF COMMITTEE NO. 3 ON HEAT POWER COURSES FOR NON-MECHANICAL ENGINEERING STUDENTS

1. What should be the aims and purposes of the courses in heat power for non-mechanical engineering students?

(*a*) Grounding in fundamental principles of thermodynamics (including chemistry of combustion).

(*b*) Acquaintance with steam, air and gas power apparatus. Knowledge of general types should be emphasized rather than details; for example in valve gears, valve diagrams need not be given.

(*c*) Ability to select and apply such apparatus, with some regard to economy of design and application.

As to relative importance, the committee feels that (*a*) is much the most important, and (*c*) should be given the least weight. Approximately the same emphasis should be placed on the steam turbine as on the steam engine, since the latter has lost its predominance.

2. Should the course in heat power for non-mechanical engineering students be the same for students in electrical, civil, chemical, mining engineering, etc.?

(*a*) The committee feels decidedly that all these students should get the fundamentals of thermodynamics. With this foundation, they have the language, the technical terms, the background, and so are equipped to read the technical literature of this branch for themselves, if the need arises.

(*b*) Beyond this foundation, the courses may very well be made different: placing less emphasis on details than with the mechanicals, requiring fewer problems; giving illustrative material for the branch of engineering elected by the student; giving more attention to particular features of interest to that branch. Thus: power plant work for electrical men; air machinery for civil and mining students; evaporators and heat transfer for chemical engineering students.

(*c*) Electrical engineers need nearly as much heat power work as do mechanicals; chemical and mining engineers need more than civil engineers and architects.

(*d*) It is realized that practical considerations such as schedule difficulties with a small number of men in a certain course may justify other treatment.

3. Should the course in heat power for non-mechanicals cover the same ground as that for mechanicals up to a given point and then stop; or should it be planned as a different course having a somewhat different aim?

Wherever practicable, a different course should be given: one aimed to cover the same fundamentals, the same birds-eye view of the fields, but differing as indicated in 2 (*b*) above.

4. Should the course for non-mechanicals be accompanied by laboratory; and if so, what should be the nature of the exercises?

(*a*) Laboratory work *should* be included in heat power courses for non-mechanicals; this should be given simultaneously with the classroom work if possible; otherwise in the term following. If given simultaneously, the experiments should be so arranged that no experiment will precede the classroom study of its underlying theory.

(*b*) The exercises should be so selected as to illustrate most fully the fundamental principles of thermodynamics. The usual preliminary laboratory studies of power-testing instruments should be followed by rather complete tests of heat power equipment. Tests should be conducted in close accordance with the A. S. M. E. Power Test Codes, omission or departure therefrom being left to individual judgment.

5. At what point in the curriculum should the course for non-mechanicals be introduced?

Heat power courses should not be begun until after the completion of courses in calculus, elementary physics and chemistry.

6. What is the minimum and what is the optimum time to be allotted to this course?

The committee feels that in no case should less than four

semester hours be devoted to this subject, but that about ten semester hours would be the proper time. Both classroom and laboratory work are included, in both cases.

7. Should the course for non-mechanicals be accompanied by any design work?

The committee feels that it is not necessary to accompany the course for non-mechanicals by any design work.

8. What should be the nature of the teaching process: how much time should be allotted to lectures, class discussions, problem-solving, laboratory, etc.?

(*a*) The course should be largely classroom work, lectures and problem-solving. Laboratory should make up about one-fourth to one-third of the total credit hours.

(*b*) Written quizzes or reviews should be given approximately every two weeks. These should come at the close of each natural subdivision of the subject.

9. Many students believe, since the course is not given in their own department and is not directly related to their major work, that it is of secondary importance. How may this notion be dispelled?

This may be done by "selling" the course to the students. The teacher should realize that his students have a right to know why the course is included in their curriculum and what it covers. At the first meeting of the class, the introduction may well consist of a lecture on the vital place of power in industry and in the daily life of the individual, with mention of the applications of heat power to the students' chosen branch of engineering. As the course progresses, further opportunities are presented to arouse the students' interest by similar explanations and applications.

10. How may better co-operation with other department staffs be secured, and better correlation be obtained with related and prerequisite courses?

(*a*) The teaching of heat power courses for non-mechanical engineering students should not be entrusted to new, untried instructors.

(*b*) The heat power instructor should confer frequently with the heads of his students' major department, to inform them how the course is handled and to report to them those students who are doing work worthy of commendation or censure.

(*c*) Graduates, writing back to heads of their major departments after graduation, with citation of cases where their study of heat engineering was of material benefit in their work, can do much to create an attitude favorable to the heat power course.

(*d*) Most important of all, members of the staff should endeavor to break down the reserve between departments (both engineering and non-engineering), so that by free and informal discussion of the teaching of related subjects, better understanding may come about.

11. How may the percentage of failures in this course be reduced?

Available information indicates that the percentage of failures runs from about 10 per cent to, in some cases, as high as 50 per cent of the students registered. The latter figure is considered entirely too high.

The committee feels that grading should not be more lenient for non-mechanicals than for mechanicals; but that the course should be so planned as to cover less ground, or to cover it less intensively, than in courses where more time is available, so that the student may reasonably be expected to get a working knowledge of the subject matter covered.

Respectfully submitted,

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## REPORT OF COMMITTEE NO. 4 ON PURPOSES AND METHODS OF DESIGN COURSES

1. The committee feels that design courses should be planned with the following objectives in mind:

(*a*) To bring to a focus and to apply the principles of mechanics, mechanics of machinery, strength of materials and related subjects as studied in the classroom, laboratories and shops.

(*b*) To develop in the student the ability to obtain and to analyze the data required for the solution of design problems, and to develop in him the ability to plan a logical method of attack and procedure.

(*c*) To develop an appreciation of the properties and limitations of materials as used in machine construction.

(*d*) To acquaint the student with the relative importance of the cost of materials, cost of production, and cost of operation and maintenance as they affect design.

(*e*) To develop creative instinct; though the committee does not recommend in general the assignment of purely inventive problems to undergraduates.

2. The relative distribution of time between recitations, problems and drafting work depends so largely on local conditions that the committee makes no recommendation in this respect. It is believed, however, that the amount of drafting required should be sufficient only to present a clear layout of the design project as a whole. Extensive detailing of the machine parts is not favored.

The assignment of home-work problems for credit is not recommended.

The employment of the so-called card method of conducting recitation work is recommended, as is also the employment of a combination of recitation and quizzes.

3. Problems used in connection with recitations should illustrate the application of formulas and demonstrate the theory. They should be concise and must necessarily be of an isolated nature. Drawing room problems should preferably be of the project or unit type—*i.e.*, specifications for a complete unit or complete machine should be given and the student

required to make the computations and necessary sketches and drawings.

4. It is recommended that, in general, the memorizing of formulas be not required. It is recommended that the student be required to develop theoretical formulas whenever applicable and in cases where these formulas are to be modified for practical application, the empirical constants or handbook formulas be supplied by the instructor.

5. The use of a textbook is recommended as a basis for recitations, supplemented by notes and references when necessary. The use of supplementary visual material such as models, manufacturers' samples, catalogs, blue prints, lantern slides and motion pictures is endorsed.

6. The committee feels that students in machine design should be acquainted in a general way with the use of welding in built-up frames and other machine parts, but it is felt that it is outside the scope of the course to teach in detail how to build up such parts. Similarly, it is felt that the student should be acquainted with national standards for machine elements and with the use of jigs and fixtures as affecting design.

7. It is the opinion of the committee that a course in machine design should be given to non-mechanical engineering students, the course to be abbreviated but to cover fundamentals.

8. It is the hope of the committee that there will be an increase in cooperation among teachers of machine design as well as a more liberal interchange of ideas and data.

Respectfully submitted,

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## REPORT OF COMMITTEE NO. 5 ON AIMS AND METHODS OF SHOP COURSES

1. To what extent should shop work be designed—

(*a*) To develop manual skill?

The development of manual skill is not the objective. It is nevertheless most important that all work be done within required tolerances. The attainment of skill is valuable, but not as important as other qualifications.

(*b*) To develop the ability to select tools and equipment for the job, and to outline the necessary operations and make instruction cards for the job?

Preparing men for positions of responsibility is becoming more important and engineering colleges should be alive to these demands. Therefore shop laboratories should afford an opportunity to acquaint the student with the problem of the selection and economical use of production equipment.

(*c*) To serve as a means for teaching principles of production methods and factory management?

This is important and should be stressed when the organization and equipment are sufficient to provide the necessary basis and ground work for such instruction.

2. To what extent should the shop be used as a laboratory for conducting experiments or researches in machine performance and machine design?

Facilities should be available so that students who have completed the required work and who have the time and inclination may continue their studies.

(In the answers to the above questions consideration should be given to the size, location and financial condition of each engineering school. It is generally understood that it is not the function of college shop courses to train expert workmen, but to teach principles that will be of greater use in engineering practice from the standpoint of the design, direction or operation of industrial plants.)

3. What shop courses are advisable for

(*a*) Mechanical Engineers, Industrial Engineers?

Pattern Making and Foundry Practice—2 semester credit hours,

Forging, Welding and Heat-treating—2 semester credit hours,

Machine Shop Work—4 semester credit hours.

(*b*) Electrical Engineers?

Pattern Making and Foundry Practice—2 semester credit hours,

Forging, Welding and Heat-treating—2 semester credit hours,

Machine Shop Work—2 to 4 semester credit hours.

(*c*) Civil Engineers?

Forging, Welding and Heat-treating—2 semester credit hours.

(*d*) Chemical Engineers?

Foundry Practice—1 semester credit hour.

Forging, Welding and Heat-treating—2 semester credit hours.

It is recommended that the time be divided into about one-third lecture-demonstration and two-thirds laboratory practice; also that Pattern Making and Foundry Practice be given during the Freshman or Sophomore years, and that Forging, Welding and Heat-treating and Machine Shop Work be given to more mature students.

4. How may shop work be made to reinforce other subjects of the curriculum?

The work in the Shop and in the Drawing and Machine Design Departments can and should be so adjusted as considerably to increase their value in several ways, such as indicating economical working limits and finishes on drawings, methods of machining for economical production, materials of constructions, etc.

The testing laboratories and shops can cooperate in the testing of the shop products.

5. Should industrial shop experience be substituted for college shop work?

Consideration should be given to all previous shop work and credit given only after sufficient evidence is submitted to convince the Shop Department that the equivalent of the required course has been covered.

6. What are some of the principal qualifications of a good shop teacher?

It is highly desirable that the shop teacher be in entire accord with the engineering type of shop training rather than the trade type. Usually the best qualified man for this work is one who has been trained in the shop and has had the necessary technical training.

In order that shop teachers may keep in close contact with factory practice they should be permitted, in fact urged, to spend the summer months with selected industrial concerns.

Respectfully submitted,

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## REPORT OF COMMITTEE NO. 6 ON THE TEACHING OF VALUES AND COSTS

The teaching of these subjects falls into two classifications:

I. Courses such as Accounting and Cost Finding where the teaching of costs is a primary object.

II. Courses such as Power Plant Design where the teaching of values and costs is quite necessary and desirable but only a secondary object.

## I

### Accounting and Cost Finding.

Your committee is of the opinion that a basic knowledge of accounting is essential for an engineering graduate and recommends that such a course be included in engineering curricula during the Junior year or earlier. This course should be given three hours a week for at least one semester, and should include at least one supervised computing period per week.

This course should be taught by, or under the very close supervision of, the Engineering School. Preferably, it should be designed for and limited to engineering students. The object of the course should be, not to make bookkeepers, but to teach the philosophy and interpretation of accounting.

Coordination of such instruction with courses in which costs are a secondary objective is essential. In the treatment of the latter a basic knowledge of accounting is of particular value.

Formal courses in cost finding should consider accounting as a prerequisite and may be optional or required.

## II

### Courses Where the Teaching of Values and Costs Is Secondary.

The Symposium on the Teaching of Values and Costs indicated that there were many courses now being given where the computation of costs constituted an important phase of the work.

An accounting course such as recommended under I above should certainly be prerequisite to a course where cost computations are required.

The Symposium indicated that in many other courses such as Machine Design, where consideration of costs has been largely neglected, it might be well to include such consideration.

If a student is to undertake any work of a nature such as might be broadly classified as engineering economics he must certainly have previously passed a course in accounting. Such

courses as Industrial Administration, Corporation Finance, and Industrial Engineering fall in this classification.

**Valuation and Appraisal.**

In the field of valuation and appraisal there is fertile soil for the consideration of the engineer and your committee suggests that opportunity for graduate work and research in this field should be provided by engineering colleges wherever possible.

The engineer will be called upon to solve many problems where his knowledge of accounting, costs and mathematics are of value.

**Engineering Economics.**

Some of these economic problems involve only a balance sheet solution. The summation of costs on one side as against expenses on the other, or a consideration of the costs of various schemes. Others involve the development of a mathematical formula and solution by means of maxima and minima.

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REPORT OF COMMITTEE NO. 7 ON TEACHING OF MANAGEMENT COURSES

1. Before discussing this subject it was necessary that your committee define the term *management courses.*

2. The term *management courses*, for the purpose of this report only, is applied to courses introduced into the curricula of engineering schools for the purpose of helping to fit young men to advance along lines leading to executive and supervisory positions.

3. Management courses included in this report:

(*a*) Economics.
(*b*) Accounting and Cost Finding.
(*c*) Business Law.
(*d*) Personnel Relations.
(*e*) Factory Organization and Management.

4. We believe it would be inadvisable even to attempt the formulation of definite regulations for teaching management courses. Therefore, we submit certain suggestions for consideration:

**Economics.**

5. All engineering students should have instruction in elementary economics. This course need not be taught by an engineer, nor is it necessary that it be taught expressly for engineering students.

**Accounting and Cost Finding.**

6. Accounting should be taught to all engineering students by an engineer, or by a teacher with an engineering background.

7. Emphasis should be put upon the fundamental principles of accounting, the analysis and interpretation of balance sheets and operating statements, and the setting up and administration of budgets.

8. Cost finding. This subject is presented by Committee Number 6.

**Business Law.**

9. Enough of the business law should be given the student to acquaint him with the fundamentals of contracts, specifications, and principal and agent. In addition he should

be made fully aware of the necessity for careful observation of the numerous laws—municipal, state and federal—which cover fire hazards, sanitation, safety, and the employment of workers in dangerous or unhealthful occupations, workman's compensation, and the creation of common nuisances. This course may be given by any qualified instructor, not necessarily a lawyer.

**Personnel Relations.**

10. This subject is presented by Committee Number 8.

**Factory Organization and Management.**

11. The teacher of this subject should be an engineer who has had considerable practical experience.

12. **Objective**—The object of this course should be to acquaint the student with the fundamental principles underlying the economic utilization of men, money, materials and machines; and with the mechanisms, systems and methods employed to that end.

13. **Content**—The principal subjects covered in this course should be: brief history of industry, plant location and layout, types of organizations, production control (routing, scheduling, dispatching, stores and material handling, purchasing), wage payment systems, depreciation and obsolescence, costs, job standardization, and inspection.

14. **Methods**—The lecture, recitation, and laboratory methods should be used. The teacher should constantly keep in mind the fact that the students should study not only what has been done and who did it, but also how to determine what to do and how to do it.

15. **Lectures** should be followed at an early date by a recitation or a quiz on the subject of the lectures. A lecture, once or twice a semester, by an outside speaker of engineering experience, stimulates the interest and the imagination of the students. Such lectures may be given during the class period, or at a meeting of the student branch of the American Society of Mechanical Engineers or other student organizations. The students should be encouraged to take notes and to ask questions.

16. **Recitations** may be conducted in a variety of ways depending upon the experience of the teacher, the type of students and course, and the location of the institution. However, interest may be aroused if the students are encouraged not to limit their information to that in the textbook. They should read other books, and management articles in the periodicals; also, if they have had practical experience, they should draw upon that for working material.

17. **Laboratory work**—drafting, school shop demonstrations, and shop visits—should be limited to material which illustrates the work of the classroom.

18. **Cooperative work** in industry is of special value in connection with management courses and is recommended. In those schools without a cooperative course, summer work in industry should be encouraged.

19. In conclusion we wish to state that in our opinion these management courses should not be given before the Junior or Senior year of a four-year undergraduate course, nor should they be taken by any student who is not, in the judgment of the instructor, qualified to profit by them.

Respectfully submitted,

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## REPORT OF COMMITTEE NO. 8 ON THE TEACHING OF INDUSTRIAL RELATIONS

After studying and discussing the methods of teaching industrial relations and the development of personality in students, your committee submits this report for your consideration, in two parts: Part I—The Teaching of Industrial Relations; Part II—College Personnel Service.

## I. The Teaching of Industrial Relations.

The fact that the graduates of our engineering colleges do not generally have the necessary point of view, background and training in the fundamental principles and practices of industrial relations has been brought forcibly to the attention of educators in the field of engineering.

These opinions, criticisms and suggestions have come from well known consulting engineers, financiers, and manufacturers. Mr. Sam A. Lewisohn, one of this group, who has a keen interest in the teaching of industrial relations, has well stated the problem as follows: "Labor relations are of vital and increasing importance in industrial management; and a large number of executives, an increasing proportion of whom are technical graduates, have no training in labor relations."

With the above situation in mind, this committee presents several questions for discussion and makes the following recommendations:

1. What is a comprehensive definition of the term *Industrial Relations?*

Industrial Relations is the securing of a working force adapted to the industry for which it is intended and the maintenance of that force in relations mutually harmonious and profitable to employer and employee.

2. What is the purpose of instruction in Industrial Relations?

The purpose is to present to students of engineering the need for and the principles and practices of Industrial Relations.

3. What subject matter should the course contain?

I. Introduction.
   - (*a*) Purposes and field of Industrial Relations.
   - (*b*) Historical background.
   - (*c*) Human traits in industry.

II. Securing the working force.
   - (*a*) Job analysis and specifications.
   - (*b*) Source of labor supply.
     - (1) Sources.
     - (2) Recruiting.

(*c*) Selection.

(1) Interview.
(2) Tests.
(3) References.
(4) Transfers.
(5) Promotion.

(*d*) Introduction to the job.
(*e*) Termination.
(*f*) Labor turn-over.

III. Maintenance of the working force.

(*a*) Training.
(*b*) Health.
(*c*) Safety.
(*d*) Factors which determine wages.
(*e*) Employee stock ownership.
(*f*) Industrial government and joint relation.
(*g*) Personnel service.
(*h*) Research.

IV. The Personnel Department.

(*a*) Organization.
(*b*) Records.

4. How should the subject matter be presented?

The subject matter should be presented as a separate course in Industrial Relations. About one-third of the time should be devoted to subject matter and the remainder to an analytical study of personnel principles and their application.

5. When should the course be given?

The course should be given to juniors, seniors and graduate students.

6. Should the course have a pre-requisite?

It is advisable that the course be preceded by a course in Industrial Organization or a similar subject.

7. What should be the length of the course?

The course should be either two or three hours per week (preferably three) for one semester.

8. To what students should the course be given?

The course should be made available to all students of engineering. It should be required of all students majoring in Industrial Engineering.

9. What books should be included in a list of books and magazines on Industrial Relations?

I. The committee recommends the bibliography under Item "A" in the Report of the Committee on College Instruction in Personnel Administration presented at the Columbus meeting of S. P. E. E. in June, 1929.

II. The committee also recommends the bibliography included in the paper by Mr. F. W. Willard, entitled, "Basic Principles and Trends in Personnel Administration," presented at the Western Electric meeting of the Summer School in July, 1929.

10. What books should be included in a short list recommended for reading by all engineering students?

The committee recommends the short list under Item "B" in the Report of the Committee on College Instruction in Personnel Administration presented at the Columbus meeting of the S. P. E. E. in June, 1929.

11. What are suitable texts for use in teaching Industrial Relations in the colleges?

The committee recommends the list under Item "C" in the Report of the Committee on College Instruction in Personnel Administration presented at the Columbus meeting of the S. P. E. E. in June, 1929.

## II. College Personnel Service.

1. The committee recognizes the value of the work done through the instrumentality of a college personnel system and recommends that all engineering schools make such service available.

2. The type of service depends upon the individual school. It should, in general, include the following:

I. The personnel record.

(*a*) Family history.

(*b*) Physical condition.
(*c*) Scholarship.
(*d*) Extra-curricula activities.
(*e*) Work and business experience.
(*f*) Personality and character development.
(*g*) Placement data.

II. The understanding that the teacher of engineering is vital to the functioning of this service and is, in the last analysis, the personnel officer.

III. Provision for some person to act as a co-ordinator of this service.

IV. The collection of information concerning each student which may be used for personality development, vocational guidance, placement or other personnel service.

V. The interpretation of the personnel record to the student as an aid in his development.

3. The committee recommends Section "F" in the Report of the Committee on College Instruction in Personnel Administration presented at the Columbus meeting of the S. P. E. E. in June, 1929, as a guide in the establishment of college personnel service.

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## REPORT OF COMMITTEE NO. 9 ON MECHANICAL LABORATORY INSTRUCTION

Were the scope of laboratory courses fixed and alike in all institutions the task of framing definite guides and suggestions would be greatly simplified. Courses in Mechanical Engineer-

ing Laboratory are greatly diversified on account of the variation in physical layout and equipment found in the different schools. The operation of the laboratory, the time allowed for such instruction and also the place provided for it in the curricula of the many institutions may be largely determined by others than the laboratory staff itself. For the above reasons, the statements and conclusions embodied in this report are general rather than specific.

**Purpose.** The function of laboratory instruction is to bear out classroom teaching; to familiarize the student with the application of fundamental theory, the principles of operation together reasons, the statements and conclusions embodied in this report writing; to develop initiative, self reliance, resourcefulness and confidence.

**Organization.** The problem of laboratory organization lends itself readily to many solutions and the following features are a few of the many which could be advanced. There should be some one personally responsible for the laboratory and the methods used therein, who should teach no less than one section of laboratory and should either teach heat engineering theory or have very close contact with the classroom work in that subject. All laboratory instructors should teach heat engineering subjects. In this latter regard, the laboratory instructor should acquaint himself thoroughly with the teaching and content of courses (even though given in another department) that relate to the experiments given under his supervision. Classroom material should precede the laboratory and where possible be given under the same department and handled by the same instructor.

The course in Heat Power Laboratory should consist of a minimum of four semester credit hours with the length of the laboratory periods not less than three clock hours. One credit should be allowed for three clock hours.

It is deemly highly advisable that all heat power courses be followed by laboratory work.

**Equipment.** The physical equipment of laboratories varies to a considerable extent and therefore it is impossible to

specify just what apparatus should be available for student courses. Concerning this apparatus, the units should be only of sufficient size or capacity to illustrate adequately the major features of such machines and they should also be of commercial proportions where possible. It is well, however, to have some large units available either in the institution's power plant or elsewhere.

**Methods of Teaching.** The laboratory class should be divided into groups or squads sufficiently small so that each member will be kept busy during the entire laboratory period. The members of each squad should rotate through the various jobs of the experiment where practicable, and a different squad leader should be chosen for each experiment performed by the squad as a unit.

Apparatus should be set up and ready for testing with the exception of movable test equipment such as gages, indicators, etc., which should be selected and attached by the students. Certain advantages of using demonstration experiments are recognized, particularly in short laboratory courses, but in general the student should perform the experiment himself.

When time is not allowed in the regular laboratory period, a class period of one hour or more should be scheduled for quiz, discussion, explanation or any other purpose concerning the laboratory instruction.

**Report Writing.** The writing of the reports may be done in the laboratory or elsewhere, but the calculations should preferably be done in the laboratory or computation room under supervision. Occasionally, printed forms may be used for result sheets, but the student should prepare his own form for the recording of observed data. General hints, suggestions or outlines concerning the preparation of reports may be given the student.

**Grading.** The grades on laboratory reports should be based on several factors such as promptness, accuracy, arrangement, neatness, composition, completeness, and conclusions.

The laboratory course grade should be determined from report grades, general attitude or conduct and the quiz or examination mark.

**General.** Undergraduate laboratory instruction is chiefly concerned with the conveying of a knowledge of fundamentals and underlying principles and therefore not too much weight or attention should be focused on the numerical results.

Respectfully submitted,

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# HIGH SCHOOL INSTRUCTION IN MATHEMATICS FOR ENGINEERING STUDENTS

BY H. M. CROTHERS

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(As delivered to So. Dak. Section, S. P. E. E. Jan. 11, 1928. Guests included High School administrators and Science teachers.)

The subject of teaching high school mathematics is one in which each one of us is interested. It is one on which each one of us has certain definite and probably rather positive ideas. It is also one on which the viewpoints of individuals are almost certain to differ according as their experience has differed. It is to be expected, I think, that teachers in Engineering colleges, will have viewpoints differing from the men in the high schools. The men in the engineering schools are apt to have uppermost in their minds certain desirable ends to be accomplished through the high school work in mathematics. They naturally tend to harp on the short-comings of students in engineering courses as they come in contact with them. They may forget that at any stage in this process we call education, it is exceedingly easy to excuse the failures by laying the blame on those responsible at some earlier stage in the development. The high school teachers are likely to have other viewpoints. They are certain to be very conscious of many difficulties not reckoned with by the engineering teachers. For one thing, they may feel that the type of training demanded for prospective engineering students is not at all suited to prospective business men, or lawyers, or doctors, and may point out that no way has yet been devised for predicting what students will enter engineering courses.

In spite of these facts, the author feels that good may be accomplished by a discussion of the subject, and especially by a discussion in which men of both groups participate. Such a joint discussion should at least have the effect of broadening

somewhat the views of each. It should lead each one to study the problem more as a whole, as one in which the solution is to be found by careful consideration of each step in the process, not by shifting the difficulties and the blame entirely on to the other fellow.

It is with the hope of leading into such a joint discussion that the author ventures to open up his views on the subject. Although the views will be presented as fully and with as much argument as time and ability permit, it is hoped that if errors exist, these will be brought out in the discussion. The views are not presented as especially new or original, but as matter to which attention should be called periodically.

The first idea to be presented here is that there should be a marked change in objective as one passes from the grade school work in arithmetic to the high school work in algebra and geometry. This statement is true because of a marked difference in the way the two subjects may be used in later life as will be described in some detail.

In arithmetic the child encounters the facts that two and two make four, that five and seven are twelve. He learns such relations as facts. Possibly he accepts them on the authority of the teacher, possibly he experiments by counting blocks and discovers them for himself. He learns the multiplication table, he learns to perform the process of adding fractions, of long division, and many other operations. As a culmination may come the manipulations involved in extracting square root, then cube roots. Now it is very important to him in later life to be able to carry through each one of these operations correctly. He may be a farmer or a banker or a lawyer faced with a situation that requires long division. The question of immediate importance is whether he can carry through the operation correctly. If he is able to do this, he may not be worried a particle by the fact that he understands little of the reasoning back of the arrangement of steps in the process, that is, he has little conception of the line of reasoning followed by the man who invented the process. In the addition of fractions he may have only the haziest ideas as to the reasons why the steps follow each other as he has learned to do them. And

he may not care much about this provided he is sure that he remembers the process correctly. Arithmetic is full of operations like this that may be very useful, one at a time, and with comparatively little reasoning required provided the process has been memorized.

In each one of these manipulations with numbers there are two questions in which the child may be interested. How is it performed? Why is it done this way? Most children find the first question much easier in most of the operations mentioned. Some may find it almost impossible to deal with the second. In later life it will be the question "how?" that faces him most of the time. Probably we all would agree that in the grade school work in arithmetic it is proper to place the emphasis in teaching upon the acquirement of skill in manipulating numbers, and to encourage but not insist upon a comprehension of the reasoning involved in inventing these operations. The primary emphasis may properly be placed on the question "how?" secondary emphasis upon the "why?"

Algebra is like arithmetic in that there are a large number of algebraic manipulations to become familiar with. There are factoring and the solution of quadratic equations and simultaneous equations, etc. And as in arithmetic many students find it easier to learn these processes as a matter of memorizing than it is to study out the reasoning behind each scheme. Students may become fairly skillful in algebraic manipulations without much understanding. They have learned these operations just as they learned the extraction of square roots in arithmetic. Any engineering teacher can testify that he has known students who had learned their algebra that way.

But algebra is unlike arithmetic in one very important respect. The manipulative skills in arithmetic are quite useful just as mechanical operations; as witness the banker or the farmer performing long division. But the manipulative skills acquired in algebra are of little use to anyone in later life, unless accompanied by a mastery and an understanding of algebra as a useful but complex tool. A man who memorizes the process of solving quadratic equations because he is unable

to follow the reasoning involved, will not have sufficient understanding of algebra to set up an algebraic equation for himself representing some problem in life, and hence will never have use for his skill. Or the man who memorizes methods of factoring but is unable to understand the reasoning behind them will never have much use for these methods, for he will be unable to attach proper significance to the algebraic expressions either before or after they are factored.

So there is a vast difference between arithmetic and algebra as they apply to later life. In one case the manipulative skill is very useful even without understanding; in the other case mere manipulative skill in the various operations is practically useless. Arithmetic may be likened to a chest of tools, any one of which may be picked out as needed and used according to directions. Algebra, on the contrary, resembles a single complex machine with infinite variety of adjustments and infinite possibilities, but one requiring an intelligent selection and adjustment of the various parts to each other for each particular job. Here an ability to mesh a set of gears, or manipulate a lever according to directions, avails little by itself.

Another important difference between the subjects of algebra and arithmetic is the age at which students commonly engage in these. Undoubtedly the students of high school age are better able to give serious attention to machinatical methods of reasoning. There is little need, probably for enlarging upon this point.

The differences just brought out, are offered as the basis for the statement that the objective in teaching algebra should be quite different from that in teaching arithmetic. Because of the age of the student and the practical value of mere manipulative skill in arithmetic, a proper objective has been described as the acquirement of manipulative skill, with as much understanding as possible, of course, but with the primary emphasis on the acquirement of skill. In algebra on the other hand the primary concern should be with the mathematical reasoning involved, not with the skill in manipulations. The emphasis should change from the "how" to the "why." Both should

be included of course but it should be recognized clearly that the "how" without the "why" is practically useless.

It is not the purpose of this paper to attempt to describe in detail the teaching methods by which the objective as stated should be worked out. The author has attempted to teach algebra and geometry at various times and has in mind some details of the way in which he might attempt the job next time but it would be folly, of course, to lay these down in detail as the methods for all teachers to follow. But there does appear to be certain general principles which may be recognized.

It would seem obvious that the stated requirements of the course, the tests and examinations, and the daily drill should all be such as to put the major emphasis where it belongs. For example, the examinations which consist in a major part of questions such as "Simplify the following expressions" or "Solve the following equations" are misplacing the emphasis because they are testing mainly the manipulative skill. This objection does not hold, of course, when such questions make up a minor part of the examinations. But the major part of the examination should consist of questions which test the reasoning power or the comprehension of principles. Such questions are admittedly more difficult to frame for it appears to be useless to expect much ingenuity from the average student when under the stress of examination. Most of the ingenuity must come from the teacher in framing the questions.

The same general observations might be made concerning the daily recitations. Algebraic manipulations should not be allowed the major emphasis there.

The arguments offered and statements made appear to apply with equal force no matter whether the student is to be an engineer, a farmer, or a doctor. If he takes algebra as a high school subject there appears to be no reason why the objective should be other than the one urged. If he is a poor student he may get comparatively little from the subject offered in this way, but he would get no more of value from the other method. There is really no excuse then for putting the phrase "For Engineers" in the title of this paper except that it may

make it seem more in order for the speaker to take up the subject. The discussion applies to algebra for any students whatever.

In the preceding discussion, it was not intended to imply that the present practise in teaching algebra is entirely contrary to that suggested here. The author is aware that many teachers of algebra have thought this subject through more clearly than it is here presented and have methods adapted to the proper objectives better than could be suggested in this paper. But taking the situation as a whole, it is felt that there is some need for improvement and that conditions might be benefited by a general shift of emphasis in the direction suggested.

Contact with students who enter the engineering courses indicates that there may be a fairly large proportion of the teaching in algebra at present in which the objective is practically the same as in arithmetic. This conclusion is indicated by the proportion of students who appear much more at home in the manipulations of algebra than in the applications of principle or the discussion of reasons. It is especially indicated when such students show by later work that it was lack of attention rather than lack of ability that caused this state. Moreover, we occasionally have such students report that they found high school mathematics quite easy and got good grades in the courses. Such a case indicates rather clearly that the algebra was taught as a subject to be learned or memorized rather than as a subject in which reasoning plays the major part. It is dangerous to generalize from a few individual cases and this will not be attempted to any extent in this connection. The author will only offer as his opinion to be compared and checked with the opinions of others, that in a fairly large proportion of the teaching of algebra, possibly half or even more, the emphasis might be shifted as suggested with considerable improvement in results.

With the comments above should go the fact that each engineering school receives many students who show the results

of excellent teaching in algebra. The criticism should not stand alone as the only comment to be made.

There are several factors or influences that tend constantly to swing the objective in algebra over to what it is in arithmetic. Most students enter algebra classes quite willing to continue accepting principles or methods upon authority, rather than attempting to stand on their own feet. In fact for the majority of students, this is much the easier and therefore the natural way. They find it quite difficult to wade through and analyze the reasoning involved, and constant guiding, or even pressure, is necessary to hold them to this objective. The habits formed in arithmetic of learning by following directions will show up repeatedly. In so far as the immediate reaction of the majority of students is concerned, they are apt to show preference for the teacher who allows them to treat algebra as an informational subject.

And the teachers themselves are likely to show the same tendencies as the students. It is easier to teach the subject when it is regarded as so much information to be acquired and so many operations to be learned. In general it is easier to show results and demonstrate progress toward this objective than it is to be conscious of progress, to say nothing of demonstrating it, when the objective is the development of reasoning power, with algebra as the tool. Moreover, some teachers of algebra, have had the subject taught to them in the way regarded as faulty. For them to swing over to the other objective means an entire change of viewpoint, and to some extent a reconstruction of the subject in their minds.

In general, then, we must recognize the influences that tend towards a misplacement of objective in teaching algebra, and take measures to counteract them. This fact is the reason for offering this discussion of the subject, and may be used to justify periodic discussions of the same subject.

It wouldn't be fair to conclude this discussion at this point. If the arguments and conclusions are worth anything applied to the teaching of algebra, they should be worth as much or more applied to the teaching of engineering subjects in our

engineering schools. We engineering teachers should be willing to take a little of our own medicine if we have need for it.

There is no doubt that the objectives in the fundamental engineering subjects should be the same as that urged for algebra. We are not interested primarily in handing out formulas to be used according to directions of the teacher or the author of a textbook. Nor are we interested especially in developing in the student the ability to work a list of problems according to a method of solution that has been demonstrated. Such drill has a proper place but it is not the objective, save in a false sense. The objective should be a mastery of the material based on understanding. The laws of nature, the mathematical methods, etc., are of little use unless accompanied by an understanding of their origin, their possibilities, and their limitations. In fact, an engineering formula used without understanding is worse than useless, it is positively dangerous. To this extent the responsibility upon engineering teachers is heavier than upon algebra teachers.

Other parallels exist. The same influences that tend toward false objectives in algebra are active in engineering subjects also. Here too the students find it easier to let someone else do their reasoning for them and accept the results of authority. And it is easier for the teacher to plan and conduct the courses that way. Just as in the case of algebra we must admit that there is too much teaching in fundamental engineering subjects with false objectives rather than the true. The need for periodic duscussions of this subject of objectives is just as great before engineering teachers as before anyone else. The opportunity of presenting this paper has been, therefore, a double opportunity.

# AN ENGINEERING SPEECH CURRICULUM

BY ALAN H. MONROE

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In an article printed in the April, 1928 issue of the JOURNAL, Professor Prescott gave a very interesting description of two public speaking courses given at the Massachusetts Institute of Technology. The scope of his paper, however, was necessarily limited to the specialized elective courses which he described. It might be of interest to outline a public speaking curriculum in its entirety so that the possibilities of this work may be seen in its completeness.

The following survey of the public speaking work offered at Purdue University is presented, not because it is better than any other, but because a consideration of it will disclose the variety of ways in which a broad speech curriculum may be of value to the engineer. The specialized work suggested by Professor Prescott is very essential and should be included in any such curriculum, but the importance of the more traditional speech courses and their *utility value to the engineer* should not be overlooked.

## COURSE WORK

*A.* The basic required course at Purdue is called *Principles of Speech.* This is a three-hour course lasting one semester. Its object is twofold: first, to develop confidence and ability in the student himself; and second, to acquaint him with the fundamental elements of persuasion and speech construction. The first object is attained by actual platform experience. Each student presents eight prepared (but not memorized) speeches during the semester, ranging in length from three to twelve minutes. In this way, over two thirds of the class time is utilized in actual practice. The student learns to speak by speaking.

The second object is attained by a study of what we call the "Motivating Process." The student is taught that to persuade an audience he must: (1) get their *attention*, (2) make them realize that a vital *problem* exists, (3) present and demonstrate the effectiveness of his *solution*, (4) make his audience *visualize* the desirability of his solution in operation, and (5) call for *action*. It will be observed that this method differs slightly from the rhetorical method of speech organization (introduction, body, and conclusion). It is based upon the principles of salesmanship and advertising. It is frankly objective in emphasizing the fact that the "speech" is unimportant but that the reaction of the audience is. In the course of the semester, the student applies this method to the selling of an article, such as a fountain pen or a slide rule; he applies it to the presentation of a project such as the installation of a sprinkler system in a factory, or such as the reorganization of production on the vertical basis in the XYZ industry; and he applies it to the adoption of a principle such as that of accurate accounting. He is taught by text, lecture, and criticism how he may best apply the Motivating Process to various types of audiences, and how he may best develop and state the facts included in each talk.

It should be noted that while the course described above is in line with the traditional beginning course in public speaking, it is *applied* so that it will have a *utility value for the engineer*.

*B*. The second course is called *Advanced Public Speaking*. It is also a three-hour course lasting one semester. This course attempts to teach the underlying causes of human action. A study is made of insinctive and habitual action, of imagery and vividness, of logic and suggestion. But again, the study is not of the theory alone but of the application of it to actual situations. A careful study is made of advertising to observe how business firms cause human beings to act. The speeches made by visiting engineers are analyzed, and reports are required on the effectiveness of a number of actual speeches made by business and professional men.

The practice work of the students is divided in two parts. During the first half of the semester, each student makes at least one platform address a week in which he applies what he has learned about securing action from audiences. During the second half of the semester, each class period is made into a conference period. The method is as follows: A number of actual cases culled from the Harvard Business Reports and other sources * are condensed and put in mimeograph form. Two members of the class having opposite viewpoints are selected to meet in conference (on the platform which is fitted like an office) in order to settle the difficulty. Each tries to win over the other to his point of view by means of persuasion.

One example will suffice. A number of mining companies are operating in competition within a small area. The president of X company favors a merger; the major stockholder in Y company favors a reduction in the value of his stock following the merger, but favors the adoption of a cooperative agreement between the two companies instead. These two men (impersonated by the two students selected) meet to discuss the situation. The points of fact are limited to those presented in the mimeographed summary. This method closely resembles the one followed in Professor Prescott's course.

*C.* The third course, called the *Occasional Speech*, is again a three-hour elective course. In it are studied the specific requirements of certain types of speech situations. The course includes a study of the "Inspirational Speech" such as is necessary at certain meetings of salesmen, managers, etc., when the purpose is to raise enthusiasm for greater endeavor; it includes the study of the technical lecture or financial report; methods of organizing and carrying out a campaign, whether sales, financial, or production, are considered; and the technic of carrying on business in conference as well as the specific nature of an after dinner speech is analyzed.

In each of these phases of study, every student takes an

* I am indebted for much of this material to Professors Sandford and Yeager of the Division of Public Speaking at the University of Illinois.

active part. He himself makes at least one of each type of speech and, as a member of the class, takes part in the discussion of all of the others. One day, he may be a member of a sales force being "inspired" by his general manager; on another he may be a member of a board of directors listening to the report of the plant manager and offering his suggestions or objections to the policies the plant manager offers; on still another day, the class may meet for lunch at the student union building and he may be on the program giving an after dinner speech to the representatives of the Indiana Public Service Companies. The good faith, imagination, and serious intent of the students in these situations, as Professor Prescott pointed out, not only increases the interest of the students but makes the practice far more valuable.

*D.* The fourth course bears the title, *Argumentation and Debate.* Again a three-hour semester course, it follows closely the traditional method of teaching applied logic. Exactly the same methods are used as are employed in any such course, except that the subjects discussed by engineering students * are engineering subjects. At the present time, for example, subjects such as the Great Lakes–St. Lawrence canal, Mississippi flood control, Boulder Dam, hydro-electric power control, and commercial aviation come in for a large share of the discussion. In this way, students are not only taught how to think and talk logically, but are given experience in the discussion of large scale engineering projects. An important element in this course is the fact that the vital relation of social, political, and economic factors to engineering is emphasized.

*E.* The next step in curricular development at Purdue should be the opening of a course in *Dramatic Production.* Such a course has not yet been opened, but it is hoped that the details can be worked out and approved in the near future. The course would deal with the technic and mechanics of play production. One hour a week would be given over to a lecture on such things as directing, grouping, lighting, and stage and scenery construction, with special attention

* Both engineering and agriculture students enroll in this course. Agriculture students discuss farm relief measures, etc.

to the new developments along these lines. For the other two hours, the class would be divided into two groups: those interested in acting, and those interested in the mechanics of production. Engineering students would be advised to take the latter choice. These two groups would then study and produce several plays during the semester, doing all the work from building the scenery and managing the lighting to acting the parts.

In addition to the cultural value which an understanding of play production would give him, the prospective engineer would learn several things of value even in specialized engineering. He would learn certain principles of color and lighting which he could apply not only in the building and lighting of a stage set but also in the design of larger units. This course would assist in impressing upon him the fact that he must not only construct a strong and efficient unit, but one that pleases the senses as well. In this way the course would squarely support the tendency in modern engineering education.

### Extra-Curricular Work

All of the above has had to do with actual work within the courses in the curriculum. But the speech work of any university is incomplete if it stops there. The extra-curricular public speaking activities often are of an equal value. Two phases of this work at Purdue University deserve special mention here: the work in inter-collegiate and intramural debating, and the work done in the speech defects clinic.

Each year, after competitive try-outs, a debate squad of eighteen upperclassmen and twelve freshmen is selected. These men ar given a rigorous training of from six to ten weeks. This training involves the experience both in research (and analysis) *on* the subject for discussion and in the actual practice of clashing on the platform. The subjects cover a variety of fields. The debaters not only get intensive training in public speaking and logic but, as one of them put it, "we learn what's going on in the world and why." Alumni who have been on the debate squad are continually dropping in to the public speaking office when they return to the campus.

Without exception they emphasize the *value to them as engineers* not only of the ability to think and talk on their feet but also of the habit built by debating of getting down to the facts and of getting the facts on all sides of the question.

One interesting development of debating here at Purdue is the annual contest which is held between the Mechanical Engineering School and Rose Polytechnic Institute. This debate is held each spring at the meeting of the Indiana A. S. M. E. at Indianapolis. The subject is always an engineering question.

In addition to the inter-collegiate debating, a series of intramural debates are held each fall. All men's organizations including fraternities are eligible to enter teams. Last year sixty teams, or in all one hundred eighty men, were engaged in these debates. A cup is given to the organization winning the tournament. The subject for this year's contests is the building of the Great Lakes–St. Lawrence canal.

So much for debating. The other phase of extra-curricular work is that done in the speech defects clinic. There are in Purdue, and doubtless in all engineering institutions, a number of students afflicted with defects in speech ranging from the worst cases of stammering and stuttering to the milder defects of faulty articulation. Last year fifteen of these students were given treatment in the Purdue clinic. Not all of them were improved, but the rather high percentage of improvement and the gratitude of those from whom a life handicap had been removed was sufficient to justify the work involved. A stammerer may be a good draftsman, but he can become much more than a draftsman if his defect is removed.

This description of the work carried on by the Division of Public Speaking under the English Department at Purdue is not complete. It is impossible to be both detailed and comprehensive in the compass of a short article. The purpose of this article will have been accomplished if it has made clear the fact that there are many points of contact between public speaking and engineering, and that a broad program based upon sound principles of speech can be made to apply directly to the specific problems of the engineering student in not one but many ways.

# MOTION UNDER CONSTANT POWER

BY L. W. TAYLOR

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Most of our engines of transportation work at approximately constant power. An automobile engine, thanks to the gear-shift, develops substantially the same power when starting that it does on the road. Street-cars develop nearly the same power when pulling slowly up a hill as when running at normal speed with a heavy load. Everywhere we see examples of motion under constant power. Yet it is safe to assert that the reader has never encountered a discussion of the laws of motion under constant power.

Physics text books are full of examples of motion under a constant force, of which simple falling is the best example. But motion under constant *force* is a a very different thing than motion under constant *power*. For example, under constant power, the acceleration becomes smaller as the velocity increases, whereas under constant force, the acceleration is always the same, whether the velocity is large or small. Again, under constant power the distance travelled depends upon the 3/2 power of the time elapsed whereas under constant force the distance is proportional to the square of the time (the familiar $s = \frac{1}{2}\, at^2$). Other facts may be deduced by a study of the six equations which describe motion under constant power. In these equations, the notation is as follows:

| | |
|---|---|
| $a$ = acceleration, | $t$ = time, |
| $v$ = velocity, | $P$ = power, |
| $s$ = distance, | $m$ = mass. |

The equations are:

$$a = \sqrt{\frac{P}{2mt}} \quad (1) \qquad a = \sqrt[3]{\frac{P^2}{3m^2s}} \quad (4)$$

$$v = \sqrt{\frac{2Pt}{m}} \quad (2) \qquad a = \frac{P}{mv} \quad (5)$$

$$s = \sqrt{\frac{8Pt^3}{9m}} \quad (3) \qquad s = \frac{mv^3}{3P} \quad (6)$$

These equations completely describe motion under constant power. Since $m$ and $P$ are constants, this set of six equations gives *every* variable ($a$, $v$, $s$, $t$) in terms of each of the others in turn. Suppose, for example, we should desire to know the velocity of a twenty horsepower, one-ton automobile at intervals of one second after it starts. The second equation gives the following set of values:

| Time in Seconds after the Start | Velocity in Miles per Hour |
|---|---|
| 0 | 0 |
| 1 | 12.8 |
| 2 | 18.3 |
| 3 | 22.5 |
| 4 | 25.7 |
| 5 | 28.6 |

This is of course assuming that the twenty-horsepower represents power in excess of that necessary to overcome friction and air resistance.

In the same way as above the distance travelled from the starting point may be computed from the third equation, and the acceleration at the conclusion of each interval from the first. Other types of information are deducible from the remaining three equations.

In making these computations it should be remembered that the value of $P$ must be in absolute units. This is always the case whenever, as here, a relation between force and motion is involved. For example, for $P$ there should be substituted not *20* but $20 \times 550 \times 32.2$. Or if $P$ is to be stated in foot-pounds per second, $m$ must be in slugs.

The derivation of the six equations is simple. If one has command of the calculus, the derivation becomes especially direct and straightforward. But even without the calculus, and with only the simplest of High School Physics at our command, we can accomplish a good deal.

For example, by definition, power is (force $\times$ velocity). But force, by Newton's second law of motion, is (mass $\times$ acceleration). In the above notation

$$P = fv \qquad \text{and} \qquad f = ma$$

Combining these equations in such a way as to eliminate $f$, gives equation (5).

Again the work done by the surplus power of the engine appears in the kinetic energy of the car. But work is (power $\times$ time) and for kinetic energy we have the familiar expression $\frac{1}{2}\, mv^2$. Expressed as an equation, therefore,

$$Pt = \tfrac{1}{2}mv^2$$

From this comes the equation (2). Combining the two equations thus derived in such a way as to eliminate $v$ gives equation (1).

Equation (3) does not come quite so simply without the calculus, but when we once have it, the others, equations (4) and (6) follow immediately by combination with the preceding equations.

It would be well if teachers of elementary Physics would utilize the wealth of material provided by the profusion of vehicles moving under constant power. Certainly there is little excuse for the common statement, completely contrary to fact, "Let us assume that an automobile moves under a constant force."

## REPORT OF COMMITTEE NO. 12—ENGLISH, JUNE, 1929

Your Committee on English during 1928–1929 has been making a study of the syllabi and less formal outlines, as they have been available, for first-year English courses for technical students in the schools holding institutional membership in the Society. We want to discover what in detail are the aims and purposes as they are directly stated or implied. A definite formulation of these aims and purposes will, we believe, lead to a better unification of methods, though we are not desiring entire standardization. A basic statement of principles, however, we hope will not only clear up our own ideas but will also be a contribution on English in engineering education.

In the year's study, the Chairman of the Committee enlisted the aid of eight English teachers, members of the Society, in addition to the Committee members, so that fourteen of the thirty-five members listed under English have actively participated. The Chairman takes this occasion to express appreciation of the enthusiastic cooperation and the excellent work done by all. Wherever possible, each was assigned a group of schools in his own section, so that he might have an understanding of the nearby educational institutions and become acquainted with their teachers of English. By this means, we have attempted to establish centers of interest for English teachers in the different sections of the United States in particular activities of the Society. Indeed, it has been felt that through definite contacts, especially with distant members of the Society, your Committee on English could extend the influence of the Society upon their professional life and render both a service. If the effort this year has been a means of stirring up group consciousness among English teachers, of increasing their interest, and of making their membership in our Society significant, we shall feel that something has been accomplished.

The fact-finding stage of our study of aims and purposes of first-year English courses has been practically completed, but the analysis is just getting under way—far enough along, however, to justify the prediction that several projects can naturally grow out of the year's effort. Only one is as yet concrete enough to warrant at this time any definite announcement. From the several reports and other data submitted from the various sections, several outlines—perhaps composites of those now in actual use—will be worked out for the information of the experienced and for the guidance of the young and inexperienced teachers of English to engineering students.

Through this study, we have been able, also, to get the names of the teachers of English in the institutions and we are expecting as an immediate Committee activity, to make up a little directory of teachers of English for engineering students. This directory we expect to have ready soon for distribution to teachers of English, deans and administrative officers and others who are interested. It should be a great help not only in circularizing the teachers of English but also in making accessible information of value. Perhaps out of this, some simple yet practical means may be developed whereby the Committee on English may keep informed as to positions vacant and teachers available, and offer help as well as be the clearing house for instructive and constructive projects in English teaching to technical students that will have significance for engineers as well as teachers of English.

Our part of the program of the Annual Meeting has been the symposium of graduate engineers and teachers of English on "What should the courses in English contribute to the preparation of the graduate?" Many who could not attend indicated their interest by requesting that they be sent any published material concerning it. We hope to be able to convey to those who were unable to attend, the spirit of the symposium and the points upon which the discussion was focused.

The contribution that the English teacher makes to the preparation of the graduate is dependent upon

1. The personality of the teacher, which obviously affects,
2. The presentation of the material, or the project, and
3. The cooperation of the instructors of the technical subjects through their handling of their class material. Indeed, the influence of the teacher of engineering subjects upon the English of the student received the emphasis.

Respectfully submitted,

SADA A. HARBARGER, *Chairman*

# ENGLISH FOR CONSULTING ENGINEERS

BY ALFRED D. FLINN

Director of Engineering Foundation

(Discussion prepared for the symposium of graduate engineers and teachers of English, Annual Meeting, S. P. E. E. Columbus, Ohio, June 20, 1929.)

Consulting, and all other professional engineers, in all writing and speaking in the performance of their services, have a primary obligation to use language *exactly* and *clearly*. They must develop keen detection of possible ambiguities of expression and skill in avoiding them. Diction must be accurate; the selection of words must be based on intimate knowledge of definitions and derivations.

Engineers should avoid jargon, both vulgar and professional. Their expressions should be convincing and interesting. For many occasions their language should be scholarly without being stilted. For some purposes they must be able to use technical terminology with full understanding, but more frequently it will be necessary to convey to readers or listeners technical concepts in language that they surely can comprehend. Some engineers will have numerous occasions to address educated persons who know but little of engineering, or to inform, interview or instruct persons of little or no education. Their messages must be interesting and understandable or their efforts will be wasted.

Brevity is highly desirable, in most cases. It is better to say much deliberately in well chosen language than to smother valuable thoughts in prolixity. There is a lesson for engineers in the old story of the Chinese interpreter who when upbraided by a speaker for letting him talk a long time without translating to the audience, rejoined, " You have not said anything yet."

Arrangement is very important and should be carefully

studied for each composition—book, report, specification, letter, even a memo. Choice of arrangement will be affected by the nature and the purpose of the composition, the medium and manner of presentation, and the characteristics of the expected readers.

In both speaking and writing the parts of a discourse should be put into a sequence that will be helpful in arresting attention, unfolding the subject connectedly and fixing the ideas in the memories of those addressed. By placing well chosen, suggestive words at the very beginnings of paragraphs and sentences, arranging the chapter in a natural order of development of the subject, and employing instructive headings judiciously, some documents and books may be made largely self-indexing, as well as more readable.

Even tabular matter and specifications may be made much clearer and more interesting by skillful arrangement, wise choice of words in headings, and intelligent use of type.

English courses, from the lowest to the highest schools, should give engineers such mastery of their language and its construction that they will be able to attain the objectives outlined in the foregoing paragraphs. Good use of language should be made almost automatical by the training given. Teachers of English in engineering colleges should inspire and equip their students with a desire and a method for continuing their progress in that language. Just as some teachers in mathematics, physics, mechanics, and engineering specialities inspire and equip their students to continue their education after graduation.

A style possessed of distinction and charm is also to be desired. Like personality, it is a real asset. Not every person can acquire a distinctive style, nor is every teacher capable of developing style. Freedom, too, should be cultivated in use of language, but mere freakishness or unconventionality should not be mistaken for freedom.

Fortunate is the man who can enrich his speaking and writing from the resources of originality in thinking, breadth of reading and keeness of observation.

Power of expression is important, but it is hollow mockery

unless backed by capacity to think and ability to do. One of the greatest requisites for effective writing and speaking is sincerity. Expression must have moral and professional worth back of its words.

English courses for the professional engineer should be planned and conducted to supply an indispensible element in his complete equipment for practise and for service as a leader in his community.

In later issues of the JOURNAL will appear other articles on English submitted for discussion at the symposium of graduate engineers and teachers of English on "What should the courses in English contribute to the preparation of the graduate?" Annual Meeting, The Ohio State University, Columbus, Ohio, June 20, 1929. The Chairman will welcome further discussion of the general topic. Address it to Sada A. Harbarger, Chairman, Committee on English, The Ohio State University, Columbus.

## 1929–30 MEMBERSHIP CAMPAIGN

On September 13 the Secretary wrote to the representative of the Society in each institution in the United States and Canada asking him to send to this office the names of all members of the engineering faculty. On this list the Secretary marked off the names of those persons who were members of the Society and to the others he sent invitations for them to join the Society enclosing an application blank for that purpose. The names of the faculty members of the following institutions were received.

On October 1 when this notice was sent to the printer invitations had been sent to 866 persons as indicated on the table. Twenty-two applications have been received to date.

The Secretary asks you to seek the men in your institution who are not members of the Society and to second the invitation which he has extended. If your institution is not listed here, ask your local representative for the reason. We are printing an application blank herewith for the convenience of those who may not have any available.

F. L. BISHOP,
*Secretary*

| Institution | Application Blanks Sent | Institution | Application Blanks Sent |
|---|---|---|---|
| Akron, University of | 3 | Louisville, Univ. of | 5 |
| Alabama Poly. Inst. | 15 | Michigan College Mines | 16 |
| Alabama, Univ. of | 13 | Michigan, Univ. of | 77 |
| Antioch College | 6 | Mississippi A. & M. | 12 |
| Arkansas, Univ. of | 7 | Mississippi, Univ. of | 10 |
| Bucknell University | 10 | Missouri School Mines | 19 |
| Case School Applied Science | 12 | Missouri, Univ. of | 6 |
| Cincinnati, Univ. of | 33 | Nevada, Univ. of | 18 |
| Columbia University | 27 | Newark College of Eng. | 16 |
| Florida, Univ. of | 13 | New Hampshire, Univ. of | 9 |
| Harvard University | 14 | New Mexico A. & M. | 6 |
| Kansas State Agri. College | 61 | New Mexico School Mines | 8 |
| Kansas, Univ. of | 31 | North Dakota Agri. | 13 |
| Lafayette College | 3 | Nova Scotia Tech. College | 8 |

| Institution | Application Blanks Sent | Institution | Application Blanks Sent |
|---|---|---|---|
| Ohio State University | 25 | Texas A. & M. | 45 |
| Oregon Agri. College | 23 | Texas, Univ. of | 25 |
| Penna. State College | 38 | Tulane Univ. | 12 |
| Pittsburgh, Univ. of | 11 | Union College | 3 |
| Princeton University | 8 | Vermont, Univ. of | 8 |
| Purdue University | 92 | Virginia Poly. Inst. | 36* |
| Rose Poly. Inst. | 19 | Wyoming, Univ. of | 6 |
| Royal Military Inst. | 6 | | — |
| Stevens Inst. Tech. | 12 | | 866 |
| Stanford University | 23 | | |

* This number of applications requested by their representative.

*Return to the Secretary, F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.*

**Society for the Promotion of Engineering Education**

Date.....

THE UNDERSIGNED desiring to become a member of THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

hereby agrees to conform to the requirements of membership, if elected, and submits the following:

STATEMENT OF QUALIFICATIONS

*Full Christian Name and Surname*.....
Print Last Name First Middle

*Mailing Address (Number and Street)*.....

*Post Office (City and State)*.....

*Full Title of Professional Position*.....
(Title) (Department)

*Full Name of Institution*.....

*(To be Signed by Two Sponsors)*

SPONSORS {
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## NEW MEMBERS

BALMFORD, J. ARTHUR, Instructor in Electrical Engineering, Columbia University, New York City. F. W. Hehre, W. I. Slichter.

BASON, GEORGE F., Professor and Head, Department of Electrical Engineering, University of North Carolina, Chapel Hill, N. C. R. I. Rees, W. L. Davis.

BEYER, ALBIN H., Professor of Civil Engineering, Columbia University, New York City. J. K. Finch, G. B. Pegram.

BREWER, ALEXANDER V., Associate Professor of Mechanical Engineering, A. & M. College of Texas, College Station, Texas. C. W. Crawford, F. C. Bolton.

CAMP, EDMOND W., Head, School, of Textile Engineering, Alabama Polytechnic Institute, Auburn, Ala. J. J. Wilmore, A. L. Thomas.

DAVIS, HARVEY N., President, Stevens Institute of Technology, Hoboken, N. J. F. L. Bishop, Nell McKenry.

DOOLITTLE, JESSE S., Instructor in Mechanical Engineering, Case School of Applied Science, Cleveland, Ohio. F. H. Vose, P. J. Zimmers.

DOW, WILLIAM G., Assistant Professor of Electrical Engineering, University of Michigan, Ann Arbor, Mich. S. S. Attwood, A. D. Moore.

GOODRICH, RALPH D., Professor of Civil Engineering, University of Wyoming, Laramie, Wyo. G. H. Sechrist, J. R. Guiteras.

HAERTLEIN, ALBERT, Associate Professor of Civil Engineering, Harvard University, Cambridge, Mass. H. J. Hughes, H. E. Clifford.

KEMLER, EMORY, Instructor in Mechanical Engineering, University of Pittsburgh, Pittsburgh, Pa. J. A. Dent, Nell McKenry.

KISSAM, PHILIP, Assistant Professor of Civil Engineering, Princeton University, Princeton, N. J. F. H. Constant, G. E. Beggs.

KILPATRICK, A. VERN, Assistant Professor of Mechanical Engineering, School of Mines and Metallurgy, Rolla, Mo. C. V. Mann, F. H. Frame.

KREFELD, WILLIAM J., Assistant Professor of Civil Engineering, Columbia University, New York City. J. K. Finch, G. B. Pegram.

LEWISOHN, SAM A., Vice President & Treasurer, Miami Copper Co., 61 Broadway, New York City. R. I. Rees, F. L. Bishop.

LLOYD, TOM C., Professor in charge of Electrical Engineering, Antioch College, Yellow Springs, Ohio. A. F. Puchstein, E. E. Kimberly.

LUCARINI, GENO B., Assistant Professor of Mechanical Engineering, University of Vermont, Burlington, Vt. V. R. Yates, J. W. Votey.

MATHESON, KENNETH G., President, Drexel Institute, Philadelphia, Pa. F. L. Bishop, Nell McKenry.

MAVIS, FREDERIC T., Assistant Professor of Mechanics and Hydraulics,

University of Iowa, Iowa City, Iowa. S. M. Woodward, C. C. Williams.

MULLIGAN, JAMES E., Instructor in Electrical Engineering, Massachusetts Institute of Technology, Cambridge, Mass. Carlton E. Tucker, Dugald C. Jackson.

SKINKLE, JAY W., Personnel Assistant, Western Electric Company, Inc., 195 Broadway, New York City. O. W. Eshbach, H. P. Hammond.

STREET, WILLIAM E., Texas Technological College, Lubbock, Texas. C. L. Swonsen, S. J. Boller.

SWINTON, ROY S., Assistant Professor of Engineering Mechanics, University of Michigan, Ann Arbor, Mich. J. H. Cissel, R. H. Sherlock.

TIMBY, EIMER K., Instructor in Engineering, Princeton University, Princeton, N. J. F. L. Eidmann, Geo. E. Beggs.

WILLIS, PHILIP A., Associate Professor of Mechanical Engineering, Missouri School of Mines, Rolla, Mo. R. E. Summers, L. Blumberg.

WRIGHT, MORRIS B., Instructor in Mechanical Engineering, Case School of Applied Science, Cleveland, Ohio. F. H. Vose, T. M. Focke.

## APPOINTMENTS

General R. I. Rees and Professor W. S. Rodman were appointed, by President Kimball, representatives of this Society at the fiftieth anniversary of the American Society of Mechanical Engineers in Washington in the spring of 1930. Dean Harold Pender and Dean J. R. Lapham were appointed alternates.

## NECROLOGY

### GEORGE A. GOODENOUGH

George A. Goodenough, of the University of Illinois, chairman of the Western Conference faculty committee on athletics and head of the Big Ten eligibility board, was found dead at his home September 29. Death was due to heart disease.

Professor Goodenough had been in poor health for some time and recently suffered a stroke of paralysis. He was professor of thermodynamics at the University of Illinois, and although well-known in engineering and educational circles, attained principal prominence as an arbitrator of Big Ten athletics, in which capacity he served for 23 years. He was chairman of the faculty committee on both athletics and eligibility. Born at Davidson, Mich., he attended Flint (Mich.) High School and Michigan Agricultural College. He was graduated from the University of Illinois in 1900 and one year later joined the faculty. Professor Goodenough had been a member of the Society since 1900.

### PETER GILLESPIE

Peter Gillespie, Professor of Civil Engineering in the University of Toronto, honoured alike as an engineering educator and as a distinguished member of the engineering profession in Canada, died on May 26th, at the age of 56 years. Following a severe illness of some four years ago, he had been warned to proceed cautiously so as to avoid undue strain, but in spite of this, continued to carry his full program of work and to take a very active part in engineering and educational matters outside his regular duties.

After receiving his early education in the Collegiate In-

stitute at Cobourg, Ont., he taught school for a period of ten years, in which he gained an invaluable experience and perfected his technique in the art of teaching. Having a natural aptitude for technology, he entered the University of Toronto as a student of civil engineering in the autumn of 1900, obtaining the degree of B.A.Sc. in 1904. Subsequently he received the professional degree of C.E. from the University of Toronto and the degree of M.Sc. from McGill University, Montreal.

In the autumn of 1904 he joined the staff of the Faculty of Applied Science and Engineering in the University of Toronto, as a demonstrator in Applied Mechanics, and rose by conspicuous merit to the position that he occupied at the time of death.

Throughout his academic career he maintained a close contact with engineering practice, having occupied various engineering positions on location and construction with the Canadian Northern Railway and affiliated lines between 1902 and 1911. Municipal engineering had a particular appeal to him and he spent some time in this branch with Sinclair & Smith, Civil Engineers of New Liskeard, Ont., and with Walter J. Francis & Company in connection with the Moose Jaw water supply. In later years Professor Gillespie was frequently called upon in a consulting capacity by private corporations and municipalities.

As an original investigator of engineering problems Professor Gillespie attained wide distinction. His research activities in connection with haunched beams, reservoir walls, reinforced concrete poles, reinforced concrete chimneys, gunite and structural welding are well and favorably known not only in Canada but in other countries as well. He gave a very great amount of time to the work of technical committees, more particularly those of the Canadian Engineering Standards Association. Only a week or two before his death he turned in for publication the final draft of the Standard Specification for Concrete and Reinforced Concrete, an undertaking that had consumed several years of time and demanded of him as committee chairman a vast amount of work.

Professor Gillespie had been a member of the Society for the Promotion of Engineering Education since 1905; had been Branch Chairman, Councillor and Vice-President of the Engineering Institute of Canada; had been Vice-Chairman of the Canadian Engineering Standards Association and a member of many of its committees. In addition, he was a member of the Association of Professional Engineers of Ontario, and of the Institution of Structural Engineers of Great Britain.

## SECTIONS AND BRANCHES

The first meeting of the **Minnesota Chapter** of the Society for the Promotion of Engineering Education for the year 1928–29 was held on Tuesday evening, February 5, at 6:00 P.M. at the Campus Club. Through the efforts of Mr. G. C. Priester, Professor S. Timoshenko of the University of Michigan was obtained as the speaker of the evening. He gave a very interesting talk on "The History of Technical Education in Russia." Mr. Timoshenko also gave a series of three technical lectures on the campus during that week. His talk to the Chapter was very interesting and instructive and was followed by questions and a general discussion. About eighty members and friends of the Chapter were present, including members of the Minnesota Chapters of the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers.

The second meeting of the **Minnesota Chapter** for the year 1928–29 was held on Tuesday evening, April 9. Dinner was served at 6:00 P.M. at the Campus Club and this was followed by the program of the evening. Mr. J. C. Lawrence, Assistant to the President of the University of Minnesota, gave a very interesting talk on the subject, "Mother Love and Engineering Education." His ideas seemed to be considerably at variance with the ideas of some who would extend the nursery walls of protection to the rising generation well up into manhood and maturity. It was also evident that he has not been at Minnesota long enough to be completely convinced of the wisdom of the so-called Norm Curve System for grading students. The discussion which followed Mr. Lawrence's talk evidenced overwhelming approval of his remarks.

R. W. FRENCH,
*Secretary*

The Spring meeting of the **Greater New York and Northern New Jersey** Section was an emphatic demonstration of the continued and increasing interest that exists in engineering education in the New York metropolitan area.

About 175 members of the S. P. E. E., both teachers and industrial leaders, met during the afternoon and evening of April 27 at Castle Point, Hoboken, N. J., as the guests of Stevens Institute.

The program was unusually informative and compared favorably with those of the national S. P. E. E. at the annual meetings.

The afternoon meeting began at 2:00 P.M. with Professor and Associate Director H. P. Hammond, Chairman of the section, presiding.

The afternoon program was as follows:

"Engineering Education Abroad"—Dr. W. E. Wickenden, Director of S. P. E. E. Investigations; New President, Case School of Applied Science.

"Born That Way"—Placement work for Engineering Graduates—Johnson O'Connor, of the General Electric Company, West Lynn, Mass.; Lecturer on Psychology, Stevens Institute of Technology.

"The Case System of Teaching Accounting to Students of Engineering"—Thomas Henry Sanders, Professor of Industrial Accounting, Harvard Graduate School of Business Administration; Lecturer in Economics of Engineering, Stevens Institute of Technology.

"Non-Degree Granting Engineering and Technical Institutions of the United States"—Mr. R. H. Spahr, of the staff of investigations, S. P. E. E.

Following the afternoon meeting, there was a tour of inspection of the Institute and a tea at Castle Stevens.

The dinner and business meeting were held in the William Walker Gymnasium, Professor Hammond presiding.

The committee on resolutions, Dean Bliss of N. Y. U., Professor Berry of U. of P., and Professor Lendall of Rutgers

presented the following resolution which was unanimously adopted:

"On this date, April 27, 1929, it has been the privilege and pleasure of the members of the Greater New York and Northern New Jersey Section of the Society for the Promotion of Engineering Education to be the guests of Stevens Institute. Through the efforts of the President, Dr. Harvey N. Davis, and a Committee of the Faculty, every possible attention has been given to the comfort and entertainment of those in attendance and included a very bountiful repast followed by inspiring and scholarly addresses from men of prominence and national reputation.

"The Officers of this section presented, during the afternoon, a very successful program of most able speakers on subjects pertinent and stimulating to the work of the teaching profession.

"*Be it resolved* therefore that the Greater New York and Northern New Jersey Section of the Society for the Promotion of Engineering Education is deeply appreciative of the courtesy and hospitality which have been so generously extended by the President, Trustees and Faculty of Stevens Institute, and

"*Be it resolved* that the members of this Association are greatly indebted to the several speakers who have so ably presented their topics and to the officers of the Section who so successfully arranged the excellent program.

"*Be it resolved* that a copy of these resolutions be sent to the President of Stevens Institute."

The committee on the Extension of Boundaries of the Section, Professor Larkin of Lehigh, Dean Prentice of Lafayette, Dean Heck of Rutgers, Dean Disque of Drexel, Director Edwards of Pratt and Professor Rockwell of Lafayette, presented the following report which was unanimously adopted:

"The Committee on the Extension of the Boundaries of the Section unanimously recommend to the New York and New Jersey Section the following resolution:

"It is the sense of the Greater New York and Northern New Jersey Section of the S. P. E. E. that the boundaries of the section ought to be enlarged so as to include engineering institutions and members of the S. P. E. E. in the state of Pennsylvania within twenty-five miles of its eastern bound-

ary and in the State of Delaware. It is also the sense of the members that the name of the Section ought to be changed to 'The Middle Atlantic Section of the S. P. E. E.,' and it is recommended that the officers of the Section request the Council of the S. P. E. E. to authorize these changes in the boundaries and name of the Section."

The after dinner speakers were a remarkable group of men who held their audience with sparkling wit, apt stories, and serious discussions. The speakers were as follows:

Howard McClenahan, Secretary of the Franklin Institute of Philadelphia.

George A. Orrok, Consulting Engineer.

Christopher Morley, Producer of "After Dark" and "The Black Crook."

Dexter S. Kimball, Dean, College of Engineering, Cornell University; President S. P. E. E.

Harvey Nathaniel Davis, President of Stevens Institute of Technology.

The next meeting will be held at the Bell Telephone Laboratories in New York City.

EDWARD H. ROCKWELL,
*Secretary.*

## COLLEGE NOTES

**The University of Akron.**—The Industrial Engineering Department was formed two years ago and has met with such a favorable response from the employers with whom we place our cooperative students that we have engaged Mr. John Adendorff as head of the department.

Mr. Adendorff came here from the Michigan State College where he served as instructor of Industrial Engineering and had charge of all foremanship training classes. He graduated from Cornell University.

**Alabama Polytechnic Institute.**—The Board of Trustees at a meeting shortly before the end of the session 1928–29 authorized the organization of an Engineering Experiment Station. Work has been started on several interesting projects and others are under consideration.

A School of Textile Engineering was also authorized and instruction begun at the opening of the present session. Professor E. W. Camp is head of the School and other members of the faculty will be secured as rapidly as suitable men can be secured. Plans for a Textile Building 300 feet long by 60 feet wide, two stories are complete and construction work will begin in a few weeks.

A separate department of Industrial Arts and Shops has been organized and in cooperation with the Department of Education is training teachers for industrial art departments of high schools and other technical schools. It is expected to develop in this department a course in Industrial Engineering.

**University of Alabama.**—Mr. Leslie A. Walker has been appointed instructor in aeronautical engineering and Mr. Donald McCuaig has been appointed instructor in engineering drawing to succeed Mr. Kenneth McDonald who resigned at the beginning of the session. Mr. Jelks Barksdale has been appointed instructor in metallurgical engineering.

The enrollment in the college of engineering is approxi-

mately thirty per cent. larger than it was last year, an increase being noted in each department. The new department of aeronautical engineering has started with an enrollment of 55 students.

**Antioch College** has increased its engineering instruction by the appointment of J. Charles Rathbun as professor of engineering. Professor Rathbun has been head of the department of civil engineering at the South Dakota State School of Mines since 1925. Previously he was assistant professor of civil engineering at the University of Washington, from which institution he received both undergraduate and graduate training.

Antioch is also to have the services this year of George F. Noltein, assistant chief engineer of the Superior Gas Engine Co., Springfield, a man who has had wide experience in European engineering circles. Mr. Noltein will be associate professor of engineering.

Carl A. Bock, vice-president of the Dayton Morgan Engineering Company of Dayton, is also added to the Antioch staff as associate professor of civil engineering. Mr. Bock received his bachelor of science degree in 1906 from Cornell College, Iowa, and his degree in civil engineering from the same college in 1908. Mr. Bock has been with the Dayton Morgan engineering company for a number of years and has been in direct charge of much of the work done by that organization in connection with the Miami Conservancy project and other projects throughout the country.

Elmer C. Foust, assistant engineer for the Springfield conservancy district, Springfield, Ohio, will assist the department as instructor in civil engineering. Mr. Foust, a Purdue University graduate, was assistant engineer for the Miami conservancy district at Dayton from 1915 to 1924, and has since worked in the field of sewers and drainage in Akron, Miami, and Louisville.

**University of Arkansas.**—C. L. Farar, Assistant Professor of Electrical Engineering at University of Idaho, Moscow, Idaho, has been appointed Associate Professor of Electrical Engineering.

A. S. Brown, a graduate of Pennsylvania State College, has been appointed instructor in Electrical Engineering.

A. G. Holmes, Jr., a graduate of Clemson College and Cornell University, has been appointed instructor in Mechanical Engineering.

**Polytechnic Institute of Brooklyn.**—Dr. Bernard Hague, Principal Lecturer in Electrical Engineering at the University of Glasgow, Scotland, has accepted the invitation of the Polytechnic Institute of Brooklyn to serve as Visiting Professor of Electrical Engineering at the Polytechnic for the present academic year.

Dr. Hague, who has degrees from the Universities of London and Glasgow, is the holder of the Siemens Medal for Electrical Engineering and the Henrici Medal for Mathematics as well as the Diploma of the Imperial College of Science for Post-graduate Research. He is a member of the Institution of Electrical Engineers, the author of several standard works on electrical theory and measurements and a recognized authority in this field.

A new plan has been developed at the Polytechnic Institute of Brooklyn whereby technical graduates in the metropolitan district may earn advanced engineering degrees by evening study. A high standard has been established for this graduate work in order that the Polytechnic may carry on creditably the professional and scientific education of these technical graduates as they find need for further study in connection with their daily work.

Dr. Hague is assisting in the Electrical Engineering Department to build up a program of graduate study to meet the requirements of this high standard established. He is instructing in two major subjects, Electric Oscillations and Electromagnetic Theory. Later he may organize a class in the Theory of A. C. Bridge Measurements. The research studies of the graduate students in Electrical Engineering will be under his direct supervision.

An appropriation has been made for the establishment of a research laboratory in Electrical Engineering for the use

of these evening graduate students. The development of this laboratory will be under the direction of Dr. Hague.

The College of Engineering and Commerce of the **University of Cincinnati** announces a five year cooperative course in Aeronautic Engineering. Professor Bradley Jones, formerly of Wright Field has been appointed Professor of Aeronautics.

The first two years of this course include the fundamental courses in mathematics, mechanics, drawing, chemistry and physics, which are basic for all branches of engineering.

In the latter years of the curriculum specialized courses in aerodynamics, and airplane, engine and propeller design are combined with work in mechanical engineering, structural analysis, metallurgy and meteorology. During the senior year each student undertakes the complete design of an airplane.

The cooperative work which will accompany this course gives the students practical experience in the manufacture of both airplanes and motors.

About thirty-five freshmen are entering the course and upper-classmen in their third and fourth years of other courses are permitted to transfer to this new department.

The **University of Delaware** started in September on the construction of an addition to the new Engineering Building. The addition will house three drawing rooms, a lecture hall, and eight classrooms for the exclusive use of the Engineering School. The building is of brick with concrete floors and tile walls, the whole made entirely fire proof. The architecture is Colonial, so as to be in harmony with the rest of the buildings on the campus quadrangle. Charles Z. Klauder of Philadelphia, is the architect.

The University of Delaware is installing this year a new course in Welding. The Welding Shop is entirely equipped with the most modern gas welding equipment for the study and practice in welding all kinds of material, including alloy materials used in airplane construction. In addition to the gas welding equipment, the shop will be equipped with hand forges, more for the sake of demonstrating the limitations of

hand forging rather than for real instruction. The shop is also equipped with modern apparatus for practice and study of arc welding.

The completion of the Mechanical Engineering Laboratory at the University of Delaware brings forth some features which are in need in college laboratories. Each steam using machine in the laboratory is equipped so that either saturated or superheated steam may be used. The superheat may be controlled at any point between 0 and 100° superheat. This will give the students adequate means of studying the effect of superheat on the economy of the different prime movers. The laboratory is also equipped with plate type air preheaters and economizers, placed behind the small laboratory boiler and the separately fired superheater in the laboratory. This will give the student an excellent opportunity to study the effect of air preheaters and economizers on the economies of steam raising apparatus.

**University of Florida.**—In the Civil Engineering Department G. E. Barnes is away on leave of absence to take part in the design of the large sewage disposal plant for New York City. This will be under Fuller and McClintock, Consulting Engineers.

In the Department of Physics, Professor A. M. Skellett is away on leave of absence to accept a fifteen month appointment with the Bell Telephone Laboratories in New York where he is taking part in researches on Trans Atlantic Telephony.

In the Mechanical Engineering Department, Professor F. L. Prescott is on leave of absence to take a position with the War Department at Wright Field, Dayton, Ohio, in connection with problems on Air Planes.

**Kansas City Agricultural College.**—The Engineering Experiment Station Record Summary for 1929 contains carefully prepared data on the administration, organization, funds, employees, channels of publication, bulletins and circulars issued, live research projects, and other data on engineering research at each of the land-grant colleges and universities in the United States.

It was published by the Engineering Experiment Station Committee of the Association of Land-Grant Colleges and Universities. The data were submitted by the directors of the experiment stations and deans of engineering and were rechecked by the deans and directors from the proof sheets. It is, therefore, the most complete and accurate summary of engineering research in the land-grant colleges and universities that has yet been issued.

From the table on pages 97 and 98 you will note that there are now thirty-eight definitely organized engineering experiment stations in the land-grant colleges and universities; that definite provision is made for engineering research in several additional land-grant institutions; that a total of $1,440,018 is available for engineering research in these institutions in 1928–29; that 925 employees are engaged either full-time or part-time upon engineering research and that 1263 engineering research bulletins or circulars have been issued.

While this Summary has been issued primarily for the use of research workers in the engineering field it contains much material of interest and value to others engaged in engineering or educational work. A limited number of copies of the booklet are available at $1.00 per copy postage paid. Orders should be addressed to R. A. Seaton.

**Michigan College of Mining and Technology.**—H. R. Reed has been appointed as Assistant Professor of Electrical Engineering. Professor Reed came here from the South Dakota State College.

C. O. Swanson has been appointed professor and Head of the Geology and Mineralogy Department to succeed Professor A. E. Seaman who has retired.

G. W. Swenson, formerly of University of Minnesota is Head of the Electrical Engineering Department established recently.

A fine new Engineering building to accommodate Mechanical and Electrical Engineering is in process of being constructed. The Mechanical and Electrical laboratories will be equipped with new and modern equipment.

**University of Michigan.**—The Departments of Mathematics, English, and Modern Languages have been removed from the College of Engineering where they have been established in the past, and placed in one general department for the University in each case.

**University of Nevada.**—Through the gift of Mr. Clarence Mackay of New York, the University of Nevada is building a $415,000 Science building to house the divisions of Mathematics, Physics and Chemistry. This building which is given by Mr. Mackay as an adjunct to the Mackay School of Mines and places the College of Engineering on an enviable footing in respect to the fundamental sciences.

The **Newark College of Engineering** opened this year with a Freshman class of about 160. Additions to the Freshmen, Sophomore and Junior classes made the total enrollment of the College about 415—the largest in its history.

The Mechanical Laboratory has been greatly enlarged during this Summer and two of the latest type Diesel engines and a number of internal combustion engines and dynamometers have been added.

The Laboratory of Physics has been doubled in size and its equipment has been brought strictly up to date.

Additions to the faculty include:

Professor William S. LaLonde, Jr., a graduate of the Massachusetts Institute of Technology and Associate Professor of Civil Engineering.

Professor A. G. Barnett, a graduate of Harvard University and Professor of English.

James H. Fithian, a graduate of Brown University and Instructor in the Department of Mathematics.

William Jordan, 3rd, a graduate of the University of Pennsylvania and Instructor in the Department of Physics.

James M. Robbins, a graduate of the Massachusetts Institute of Technology and an Instructor in the Department of Civil Engineering.

**The Pennsylvania State College.**—The new Engineering Building was occupied at the beginning of the semester. It is 175 feet long, 50 feet wide and three stories in height, with a basement, including a mezzanine floor. The latter is devoted to an hydraulic laboratory arranged for instruction and investigation. One of the features is an amphitheatre arranged for hydraulic demonstrations.

The building contains the offices of the Dean, the heads of the Departments of Architecture, Civil and Mechanical Engineering, with members of their staffs.

**Purdue University.**—The following have been appointed on the engineering staff for the school year 1929–30:

Fred L. Serviss as Associate Professor of Geology. Professor Serviss is a graduate of the Colorado School of Mines and comes to Purdue from the Catholic University of Washington where he has been Head of the Department of Geology.

R. L. Farrabee, Assistant Professor of Metallurgy. Professor Farrabee comes here from the University of Alabama of which college he is an alumnus.

G. W. Haskins, Associate Professor of Aeronautical Engineering. Professor Haskins has had several years of active service in the Aviation Division of the U. S. Army, in engineering research at Wright Field and in manufacturing aeroplane equipment. He is a graduate of Purdue in the class of 1916.

Gerald H. Venemann, an alumnus of the University of Colorado, as Associate Professor of Refrigeration. Professor Venemann has had about twenty years of refrigerating experience.

C. W. Messersmith, Instructor in Mechanical Engineering. Mr. Messersmith is a graduate of this institution and for the past two years has been Assistant Instructor in Engineering in connection with A. R. A. draft gear tests which are in progress at Purdue.

Maurice C. Fetzer, a recent graduate from the University of Minnesota, as Instructor in Chemical Engineering.

E. E. Reynolds, Instructor in Electrical Engineering. Mr. Reynolds has been in private business for more than twenty years. He was at one time connected with the University staff as a teacher.

C. M. Shaffer, Instructor in Electrical Engineering. Mr. Shaffer is a graduate of Bucknell University, and has had teaching and practical experience.

C. F. Siskind, Instructor in Electrical Engineering. Mr. Siskind is a graduate of Carnegie Institute of Technology and has had several years of practical experience in power and substation construction.

H. E. Wise, Assistant in the Hydraulic Laboratory. Mr. Wise is a graduate of Purdue, with several years of experience.

John Hedberg, Instructor in Civil Engineering, a recent graduate from Cornell University.

Paul Bauer, Instructor in Mechanical Engineering. Mr. Bauer is a graduate of Ohio State University in 1921, since which time he has been in practice.

C. R. Egry, Instructor in Machine Design. Mr. Egry is a Purdue alumnus and has had four years of experience.

H. V. Kemmer and J. E. Carson, Assistants in Civil Engineering. Both of these men are recent graduates of Purdue University.

P. E. Moose, a recent graduate of North Carolina State College, as Instructor in Practical Mechanics.

A. H. Carter, Instructor in Practical Mechanics, a graduate of Ohio State University.

C. W. Caldwell, Instructor in Practical Mechanics, a man with considerable experience.

Paul Binns, Instructor in Practical Mechanics, a graduate of Tufts College.

**Syracuse University.**—LeRoy A. Mullin, formerly Assistant in the Research Department of the Massachusetts Institute of Technology, has been appointed Assistant Professor in Electrical Engineering in the College of Applied Science,

Syracuse University. Professor Mullin succeeds Professor W. E. Mueller who has joined a legal firm in Syracuse, specializing in patent law.

Last June, the Guggenheim Fund for the Promotion of Aeronautics, Inc., made a grant of $30,000 to Syracuse University to establish a course in Aerial Photo Surveying and Mapping in the College of Applied Science. Five experts have accepted the invitation of the Chancellor to act as an advisory board in connection with the planning of the new course. The members of this Committee are:

Carl S. Bausch, Manager of the Bausch & Lomb Optical Co., Rochester, N. Y.
J. B. Beadle, of the Brock & Weymouth Co., Philadelphia, Pa.
Col. Claude H. Birdseye, Chief of the photographic Division, U. S. Geological Survey, Washington, D. C.
Sherman M. Fairchild, president of the Fairchild Camera Co., of New York.
Captain E. S. Land, vice president and treasurer of the Guggenheim Fund, New York.

**Tulane University.**—Stanley Thomas Hall, one of the principal buildings of the College of Engineering, is being remodelled by the addition of a new roof which will have the effect of adding an entire new floor to the building, making it four stories instead of three.

This new floor will afford much needed additional space for drafting rooms to take care of the increasing demands of the School of Architecture.

Mr. Arthur M. Hill has been appointed to the position of Instructor in Mechanical Drawing and Machine Design to succeed Mr. Gilbert H. Dunstan, resigned. Mr. Hill is a graduate of Tulane in the class of 1924, and since graduation has been with the General Electric Company, and has also taken graduate courses at M. I. T.

**Union College.**—Mr. Herman C. Beeckel, E. M., Lehigh, 1922, has been appointed an instructor in Civil Engineering in the place of Mr. Eric Nygard, resigned.

A new Department of Thermodynamics and Applied Mechanics has been formed to take over courses in these general subjects formerly given under the Departments of Civil Engineering, Electrical Engineering and Physics. The object sought in forming this department has been to prevent duplication of work in the three departments mentioned. Hydraulics and Testing Laboratory remain in the Civil Engineering Department.

A new Amsler fifty thousand pound universal testing machine has recently been installed in the testing materials laboratory. This machine has provision for seven ranges of low capacity and with it precision of measurement can be attained which was not possible with the older machines.

**Virginia Polytechnic Institute.**—Patton Hall of Engineering was completed and occupied at the opening of the session. This attractive, four-story building, two hundred and seven by sixty-seven feet, Gothic in style, becomes the principal center of the School of Engineering. It houses the departments of Civil Engineering, Electrical Engineering, Applied Mechanics, Power Engineering, Architectural Engineering and Industrial Engineering, as well as the offices of the Dean of Engineering.

### *Faculty Additions*

Paul T. Norton, Jr., Professor of Industrial Engineering. Professor Norton was formerly of the engineering faculty of the University of Wisconsin and previously was Vice-president of the Kilbourne & Jacobs-Case Crane Company of Columbus, Ohio.

H. S. Grenoble, in charge of Bureau of Extension Instruction. He was formerly with the Extension Division of the University of Wisconsin.

Francis J. Sette, Associate Professor of Sanitary Engineering. Professor Sette has been associated with Lederle & Provost, consulting sanitary engineers of New York City.

John P. Mahaney, Assistant Mechanical Engineer, Engineering Experiment Station. Mr. Mahaney has been in the

laboratories of the Norfolk & Western Railway at Roanoke, Va.

Karl J. Belser, Instructor in Architectural Engineering.

P. S. Dear, Instructor in Ceramic Engineering.

### *Promotions*

J. E. Lodewick, Professor of Wood Technology; J. B. Jones, Associate Professor of Applied Mechanics and Experimental Engineering; W. T. Hartman, Jr., Assistant Professor of Civil Engineering; P. H. McGaughey, Assistant Professor of Civil Engineering; N. W. Conner, Assistant Professor of Mechanical Engineering; C. C. Hill, Assistant Professor of Graphics.